The American horologist and jeweler

Vol. 21 September 1954 No. 9

INCORPORATING HOROLOGY

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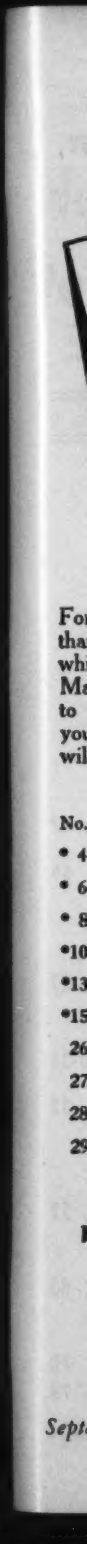

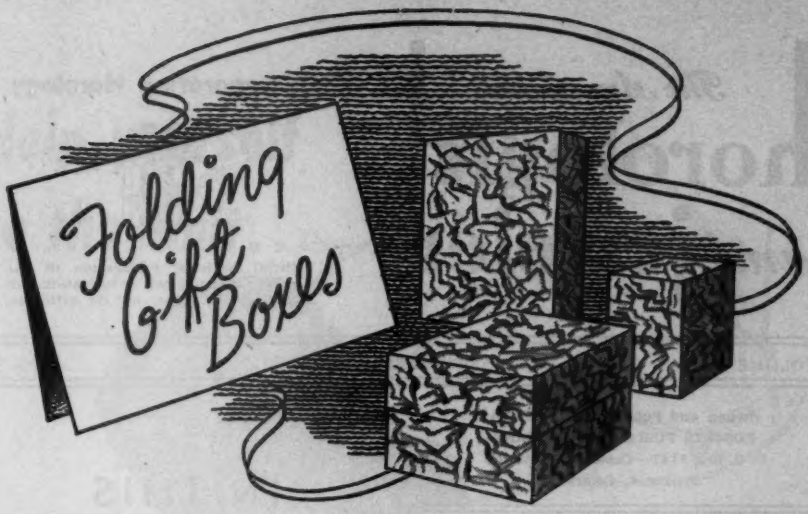

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IN THIS ISSUE

FEATURES:

How to Reduce Comebacks To a Minimum (Lecture 1) 17

Public Relations For Horologists 66

DEPARTMENTS:

Information Please 22
By W. H. Samelius

Watchmakers' Contest 30-31

Clockwise and Otherwise 32
By J. E. Coleman

The Watch Repairman and the Oscilloscope 52
By Carl H. Anderson

Jewelry Repairing 62
By R. Allen Hardy

Industry News 70

Advertisers' Index 78

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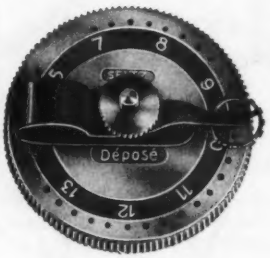

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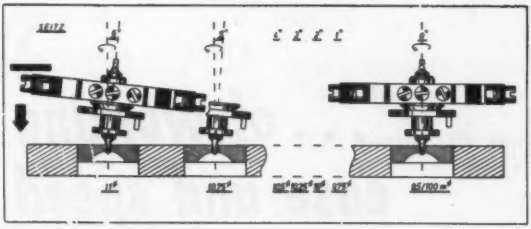

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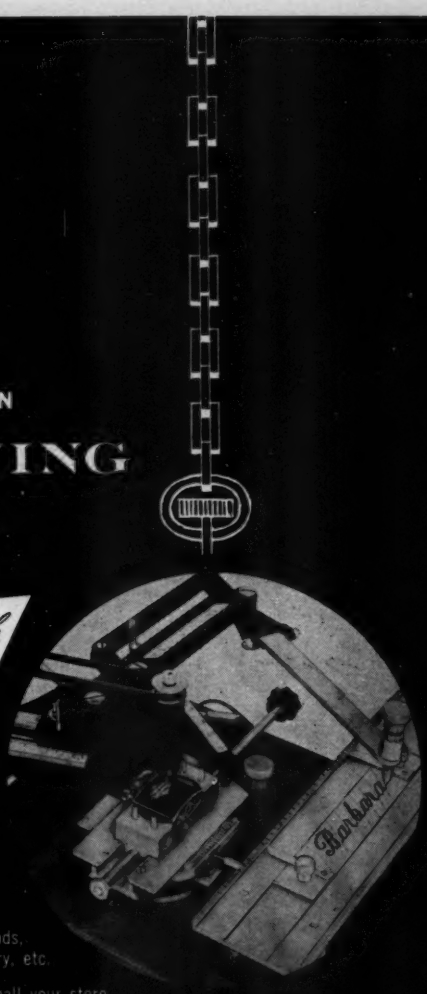

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#310H—3x10x10½
#3511H—3½x11x10½
#3511R—3½x11x14
#413E—4x13x9½
#413H—4x13x10½
#412E—4x12x9½
#411K—4x11x11½
#4514H—4½x14x10½
#4513E—4½x13x9½
#4513G—4½x13x10¼
#515C—5x15x8½
#514C—5x14x8½
#513C—5x13x8½
#513E—5x13x9½
#513H—5x13x10½
#512E—5x12x9½
#511H—5x11x10½
#511K—5x11x11½
#511P—5x11x13½
#510H—5x10x10½
#614H—6x14x10½
#613E—6x13x9½
#613H—6x13x10½
#611H—6x11x10½
#611K—6x11x11½
#611P—6x11x13½
#610H—6x10x10½
#610K—6x10x11½
#695M—6x9½x12½
#6514F—6½x14x10
#6511J—6½x11x11
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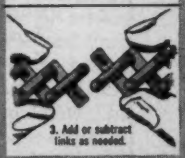

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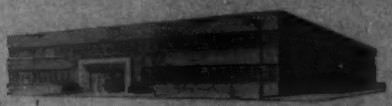

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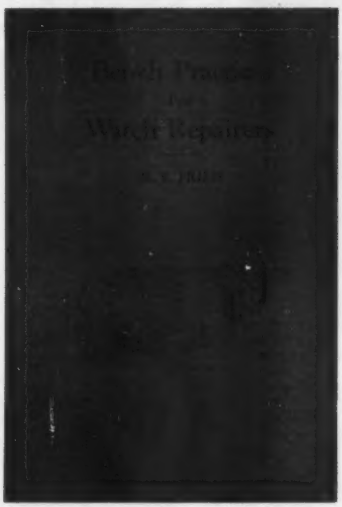

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Volume 21 September, 1954 No. 9

How to Reduce Comebacks To a Minimum

Lecture 1—INTRODUCTION

By DR. H. ATLANTIS SUDBURY

The first in a recent series of 13 lectures delivered before the Horological Assn. of California. (All rights reserved).

I can truly say it gives me great pleasure to lecture before you. In the past—since 1926 when I first started to teach watchmaking,—we, as teachers, have had to start teaching students from the beginning. You are members of the profession and have had considerable experience at the bench. Nevertheless, I doubt if there is a man here that can design and make a watch. If you can't—then you are not a Watchmaker. If you can't take a sextant and pick out a star and calculate the exact minute, then you are not an Horologist.

Then what are we?—We are watch repairmen.

At this time we will consider the most unprofitable and aggravating problem in the jewelry industry; namely, the good-for-nothing, unpredictable comeback.

There is nothing more aggravating to a customer than to have his watch stop only a short time after it has been picked up from the jeweler. The customer has paid a fair price to have the watch repaired and he has a reasonable right to expect the watch to run and keep fairly accurate time. If the watch fails to function properly, and he has to bring it back several times, he soon loses patience with the watch, with the watchmaker, and with the retail jeweler. All this reflects on the integrity of the industry, and before long the customer is inclined to condemn all jewelers and watchmakers as unreliable and incompetent.

All customers are human, and they all have friends and relatives who are all potential customers of the retail jeweler. If the customer has received a poor job on his watch and he has to return time and time again to get satisfaction, it is a cinch that he will talk among his friends and relatives. This gives the retailer a bad reputation. On the other hand, if the customer is satisfied with his first visit to the store, he will be more than willing to tell his acquaintances of the fine jeweler and watchmaker he has found. This kind of advertising is by far the best and most effective advertising any store could possibly have, and it doesn't cost you one red cent—just do the job you are paid to do, and do it right, and you will receive the full amount of advertising free of charge.

Watchmaking is a profession, whether or not we in the industry consider it so. Most all members of the professions, such as Doctors, Lawyers, Dentists and the like, are not permitted to advertise as a matter of ethics. They rely entirely upon "word of mouth" advertising to build their reputation and clientele. This same procedure should be followed in watch repairing.

How often have you heard the remark "I'll send you to *my* doctor", or "*my* dentist", or "I will ask *my* lawyer". This same statement can be translated to "*my* watchmaker" for the benefit of the retail jeweler and for the entire industry—if we can and will *reduce comebacks to a minimum.* This phrase "*my* watchmaker" can become a reality for your store.

Literally thousands of examples of comebacks and the conditions that caused them to come back can be related. Every watch repairman has had them, and he has eventually found the cause for the comeback. Nevertheless, if the watch repairman had followed a precise schedule in repairing the watch, that watch would never have been returned to the store until it was time for another overhaul.

It is easily understood that every watch is an individual problem and that each watch must be repaired according to its quality and its potential capabilities. A seven-jewel hack movement cannot be expected to keep time like a fine high-grade seventeen or twenty-one jewel watch. The customer should be informed of these facts and he will know that inaccurate timing is the result of mechanical limitations of the watch and not the inability of the repair man.

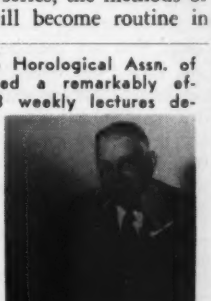
Even though each watch is an individual problem in its repair, there is still one basic method to follow in bringing that watch to time on the rate-recording instruments. It is this one basic method of overhauling a standard stem wind movement which we are going to discuss during these lectures. Other types of movements, self-winding, calendar, and chronographs will also be discussed, but we will always follow the same basic procedure of repair and check.

During the many years I have spent as a teacher of horology, and as a retail jeweler I learned many things about customer psychology and pedagogy. These experiences have been invaluable to me in my present position as a Consulting Horologist. I have learned that anything that is good for customer relations is also good for the retail jeweler. Anything that can save time and money for the retail jeweler is also good for the watch repair man. And if the watch repair man can do a better job for the retailer and the customer in less time, and more economically, then everyone concerned is greatly benefitted by this knowledge.

It was not until a year and a half of work as a Consulting Horologist that I knew that watch repair men could be instructed to repair watches—and to check them—so that there would be absolutely *no* comebacks—and I mean *no* comebacks—not a few—but none whatsoever. I have had some comebacks of my own—but that was because I violated my own methods of repair and check. Occasionally one may skip something, and there will be a comeback, but there is no reason why any of you should have comebacks if you will follow precisely the repair and check schedule we will discuss throughout these lectures.

If this schedule is followed religiously during these lecture series, the methods of repair and check will become routine in

Early in 1954 the Horological Assn. of California commenced a remarkably effective series of 13 weekly lectures designed to refresh the memories of watchmakers in the southern part of the State on the importance of reducing comebacks to a minimum, plus acquainting the watchmakers with allied branches of their profession.



DR. SUDBURY

Dr. H. Atlantis Sudbury, whose fifty years of experience in watch factories, retail jewelry stores and at the bench has earned him the title of West Coast Dean of Watchmakers, was selected as the principal lecturer of the series. Included in the reprinting of the series, beginning this month in A.H.&J., will be presentations by Norman D. Luth, Samuel Levin, Louis Hayman, Victor H. Gateman and Richard Romanelli.

your daily work, and you will follow these methods for the rest of your life. It is only when you become over-confident, or a little lazy, that you will again have a flock of comebacks on your bench each morning.

A watch repair man must be alert at all times, he must be accurate and exacting in his work. He must be alive to the changes that are taking place around him in the field of horology. New and better designs of watches are always being created; the automatic, chronographs, calendar watches, ballbearing watches, etc. These demand your attention, so when one comes to your bench, it will not be entirely a stranger to you.

You must study the current publications of the industry. One day a young watchmaker asked me "How do you do so-and-so"? Right in front of him was a copy of the *American Horologist & Jeweler.* Fortunately, I had read the article the evening before, so I picked up the magazine and handed it to him. Told him to read his publication and he would find the answer. He later confessed to me that he had not read one article in the magazine for over a year. He said he was too busy. He is a ski enthusiast and can't wait for quitting time to pursue his hobby. I believe every person should have a hobby—but it is a luxury which should never be pursued at the expense of our daily bread. Never neglect your profession for personal pleasure. If you strive to become expert in your profession, you will find far greater pleasure in your work.

Furthermore, if your profession is distasteful to you, and it has become a burden, find another way to earn a living. Don't make yourself unhappy — and all others around you—life is too short. In other words, if you don't like your job, why don't you quit? It is only human nature to dislike doing something if you don't know exactly what you are doing. The solution to that problem is to study and learn exactly what you are trying to do, and positively know how to do it. Take pride in your work—be proud of your profession. Be an asset to the industry. That is the purpose of these lectures.

The average employer is a pretty square-shooting individual. Perhaps he started his jewelry store by working at the bench himself. He has some idea of the bench problems. He has a right to expect a profit in his repair department. He also knows that his repair department is the best advertisement he has in the store. Usually about one-fifth of his gross income is from the repair department—yet the advertising expense of that department is only 2% of his total advertising dollar. He knows that as his repair department increases business, so do all other departments in his store increase. The same is true if his repairs fall off—he also falls off in all other departments proportionately.

The ethical retail jeweler does not expect his watch repair man to repair eight, ten or fifteen watches daily—because he knows it is impossible to do justice to so many. If the watch repair man will correctly overhaul four watches daily at a fair and reasonable price to the customer, the jeweler will be happy and he will make a substantial profit in the repair department —and pay the watch repair man a livable wage.

On the other hand, if the watch repair man must spend the entire morning winding watches, hanging them on the board, adjusting comebacks, putting on watch band sales, polishing cases and some jewelry for the boss' wife, there will be little time for new and constructive work, and the net profit will be very discouraging at the end of the month. Be jealous of your time. Use it well and to the best advantage of your employer during the forty hours you are paid for your services. The boss will thank you for it, and he will raise your salary—if you can produce without comebacks.

• • •

Any time you are dealing with the general public, there are many things the customer is responsible for in the way of comebacks. It is not always poor workmanship, or sloppy indifference. Broken balance staffs are the most common. Very few persons will admit the watch was dropped. Don't force them to admit they were wrong. It will only irritate them, and you may lose a customer. Admit you have broken your own balance staff occasionally without knowing exactly how it was done. But still charge the customer for the job. Never argue with a customer. Agree with

them as much as possible, but make allowance for the difference of opinion. Every customer is like every watch, they are an individual problem and we cannot possibly discuss all phases of customer relations at this time.

One of the more common difficulties with comebacks is magnetism. Our electrification of kitchens, offices, laboratories, shops and even blankets has decidedly increased this hazard of the watch repair man. There are some watches, and I dare say you have had them in your shop, that positively defy demagnetization. Even if you take them down piece by piece, the magnetism is still there. I have spent many hours in research in my laboratory on this very subject. I have it licked, absolutely and positively. I will tell you exactly how you can do it yourself during these lectures.

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Here are a few of the most prevalent difficulties found to be the cause of comebacks. Of course, there are almost as many causes as there are comebacks, but for the sake of time and space we will discuss only a few.

Too strong a cleaning solution—or leaving it in the cleaning solution too long. This will eat away small particles of the brass balance wheel and balance screws. The watch will take off like a sabre-jet. Timing washers can be placed on the balance screws, but the side shake of the balance staff may cause the screw head to touch a plate and stop the watch. Watch the time in the cleaning solution. I have seen many watches that have been ruined in this manner. I have seen nice watch movements with the nickel plating eaten off by too strong a solution. Don't ever be guilty of this destruction of personal property.

Don't tear out a balance staff from the wheel by using a "balance staff remover". Chuck up the staff on the collet shoulder and cut away the hub of the staff with a sharp pointed graver. If you use a carboloy graver, never let the point of the graver get below the line of center, or you will snap off the point of the graver.

Keep your bench clean—yes, I mean *clean*—just as clean as an operating room, if it is possible. Lint and dust are two of the worst enemies of the watch repair man's art. Never have a linty cloth near the bench. Use a Sylvet cloth or a piece of hard broadcloth near the bench. I have found tobacco, cigarette ashes, and bunny-sweater fuzz in some stoppers. I have even found dandruff from the head of the watch repairman in several comebacks. Don't let this happen to your watches. Keep your bench clean.

Keep all your tools clean and slightly oiled at all times. Keep your cleaning solution always fresh. Change rinse often. It is cheap insurance. Brush out and blow out your cleaning baskets after each watch has been run through the cleaning machine. Lint will collect on the mesh of the basket from dirty watches. Keep a hand-blower before you at all times and use it often—it will pay dividends in the long run.

Occasionally you will want to hand clean a part of a watch with benzine or carbon tetrachloride. Be sure your supply of cleaning solvent in your bench cup is changed often. When you dry the part in boxwood sawdust that has been heated, don't let the particles of sawdust get on the bench. Change the sawdust often. It becomes contaminated quickly and is slightly oily after repeated using.

Oil is one of the most important factors in good watch repairing. Keep it clean. Change the oil in your oil cup daily. Keep it covered when not in use. Keep your oil supply in a dark, cool place. The cheapest oil is usually the most expensive in the long run, because it may lack some desirable quality for oil. During this lecture series, I will tell you how you can test your oil yourself, so you can determine exactly what brand of oil you want to use at your bench. I will tell you about fountain oilers and other gadgets made for the man at the bench.

One of the most prevalent errors of many watchmakers is "over oiling." Use only a very small amount. I will tell you exactly how to gauge this amount in another lecture. Keep your oilers clean and the point well protected at all times. Push the point of the oiler into button pith wood before each dip in the oil cup. This movement will become automatic after you

have done it for a week, and you will not be slowed up any appreciable amount in your repairing time.

When pegging out the holes of the jewels, be certain you have a sharp piece of pegwood. Keep it sharp at all times. You will notice there is a little pegwood dust around the opening of the jewel hole after each operation. Be sure this is all blown free from the jewel before placing it in the cleaning solution. Don't be afraid to use pegwood. Use it often and use it long and hard. It is good assurance for clean jewels and jewel holes.

Completely disassemble every watch you intend to overhaul. Do not forget the complete winding assembly, and full dial train. It only takes a few minutes to do the job right. Cleaning solution will not do an adequate job without being able to reach the dirty surface of the stem, clutch, and winding pinion. So why leave that dirt in there? You are not hired to be lazy—take the dirt off!

Always polish the case, and cement the crystal. Put on a clean black cord on all cord bands. Don't be afraid of doing a little something nice for a customer. Remember, the customers can't see the inside of the watch—all they see is the outside—and if you make that part look good as new, they will appreciate it. If the crown is too small or badly worn, you might replace the crown. Try to sell the customer a new one first, and if he refuses, you can give it to him. People today are always looking for something for nothing. You might butter them up a little occasionally. Always try to sell a dial refinish job with each watch repair if the dial is the least bit scratched, tarnished or faded. They will thank you for it when they get their watch back as pretty as new.

Try to make the customer feel you are doing these extra things just for him, because he is a valuable customer. Don't leave the impression you do it for everyone. Make the customer feel at home, be friendly but not impertinent or familiar. Always speak first to every customer that comes in the door. Don't scowl at them if you are busy at the bench. Excuse yourself for a second while you cover up everything delicate and clean on your bench. Use the bell jar for every open movement when you are not working on the movement. Don't try to do too much for the customers while they wait at the counter. This cuts down on the amount you can charge the customer for a service, and it throws you off schedule on all the other customers' watches you have promised for delivery.

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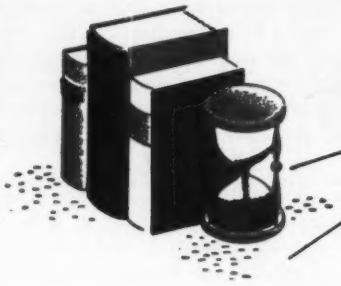
I am glad we have talked over these things, because we have cleared the decks for action, and in all subsequent lectures we will get right down to actual work of taking a watch apart for the purpose of overhauling. We will end up by putting it together and checking it completely. Our object is to teach you how to repair or replace correctly any part of a watch in the shortest possible time. How to repair and check a watch so that there will be *no comebacks.* The most important step is in checking the watch after it has been repaired. If this is followed carefully, nothing will get by you to cause a comeback. We will discuss the inspection of comebacks to determine the exact cause of their return to the bench.

We will study separate parts of the watch. Follow carefully and exactly the instructions given at these lectures, and these procedures will soon become a natural habit, and by the end of this series you will be handling the watch in a proper manner, and you will have eliminated the most aggravating, unpredictable, good-for-nothing comeback.

(Next month Dr. Sudbury discusses "magnetism.")



INFORMATION *Please*

WH: I see many advertisements calling for a 10 chuck combination lathe. How many chucks are required for the average run of watch repair work?

Answer: You should have as complete a set of chucks as you can afford—without proper sized chucks it is to your disadvantage to properly do your work. Closing a chuck that is too large for the work will throw the chuck out of true, and crowding a piece of work into a chuck that is too small will have the same effect. A nice assortment of chucks to have would be as follows: 3, 4, 5, 5½, 6, 6½, 7, 7½, 8, 8½, 9, 10, 12, 14, 16, 18, 20, and then alternate numbers through No. 40 which you will find useful and no doubt take care of the average run of work you will encounter. Five or six wheel chucks, an arbor chuck and a number of cement brasses will round out your collection nicely.

SBJ: I recently repaired and cleaned an old 18S single roller watch. It runs fine in the shop, but as soon as the customer wears it, it stops. I lift out the balance bridge, swing the watch back in beat and the watch runs o. k. What can I now do to keep this watch out of the shop and stay with the customer?

Answer: No doubt you have spent a lot of time with this watch, however, when repairing these old roller jobs, you must see that there is very close side shake for the balance pivots and pallet arbor as well as the escape wheel pivots. This is your first move; by means of the banking screws adjust the lever so that the roller just passes through corner of the fork slot with approximately .001 inch shake. Naturally, the roller jewel must be upright and the face of the roller jewel at right angles to a center line of the staff, test the guard pin assuring yourself it is tight and bring it forward to the roller table within .0005 inch clearance. Test the safety action of the guard pin—it should not pass by the roller nor should it have a wedging action. See that the periphery of the roller table is perfectly polished; if you take these precautions you should have no further trouble in keeping the watch out of the shop.

AWA: Can timing washers be placed directly opposite each other and still have the balance in poise?

Answer: This question is repeated at intervals and theoretically it should be so, however, there are certain factors which may enter into the operation. When placing the washers, there is the possibility of throwing the rim out of round, especially if the balance screw threads are tight and the balance has a soft rim. This may not be a visible amount, but enough to throw the unit out of poise. There is also the possibility that the timing washers may vary a little in weight, even though they are from

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the same bottle. If you want to play it safe when working on a high grade watch, test the balance for poise after putting timing washers on the balance, then you will be able to determine whether or not the balance is out of poise.

CF: I am having trouble in the assembling of cuckoo clocks, especially the striking mechanism. Should the bellows play first and then the gong strike, or should the gong strike first and then the bellows?

Answer: The customary procedure is to have the gongs strike first and then followed by the cuckoo bellows.

LE: I traded an old watch for a watch which now has me puzzled. The dial is marked for ten hours and has 100 marks on the minute track, the cannon pinion is missing. I would like to know how to replace it. The hour wheel has 35 teeth, minute wheel has 40 teeth and the minute pinion has 14 leaves.

Answer: The dial train being a compound gear of two reductions, the ratio for the decimal train is 10-1. Dividing 10 by 2, we have two factors, 4 to 1 and $2\frac{1}{2}$ to 1. Checking your train you will find the number of teeth in the hour wheel is 35, and divisible by $2\frac{1}{2}$, making 14 leaves for the minute pinion.

Dividing the number of teeth in the minute wheel of 40 teeth by the other factor of 4, you will have the number of leaves in the missing cannon pinion, or 10 leaves. Thus: $35 \times 40 \div 10 \times 14 = 10$ to 1 ratio.

MJM: Kindly explain the difference between the tonneau and cushion dials and the proper type bezel for each watch.

Answer: The tonneau crystal is barrel shaped having straight ends and slightly rounded sides, the cushioned shaped crystal is rectangular, having four slightly rounded sides. The bezel openings are made to conform with the size and shape of the numerals on the dial while the bezel may be of any shape, for outside design in keeping with the current styles.

AMcC: I have come into possession of a Dudley watch made in Lancaster, Pennsylvania. It is 12S and has 19 jewels with separate bridges and the Masonic emblem. Can you give the history of the watch and how many were manufactured?

Answer: John Bowman of the Bowman Technical School, Lancaster, Pennsylvania, offers the following information: An article giving the history of the Dudley Watch Company shows the remaining parts of the unassembled watches of the Dudley watch were sold to a J. F. Apple, manufacturing jeweler.

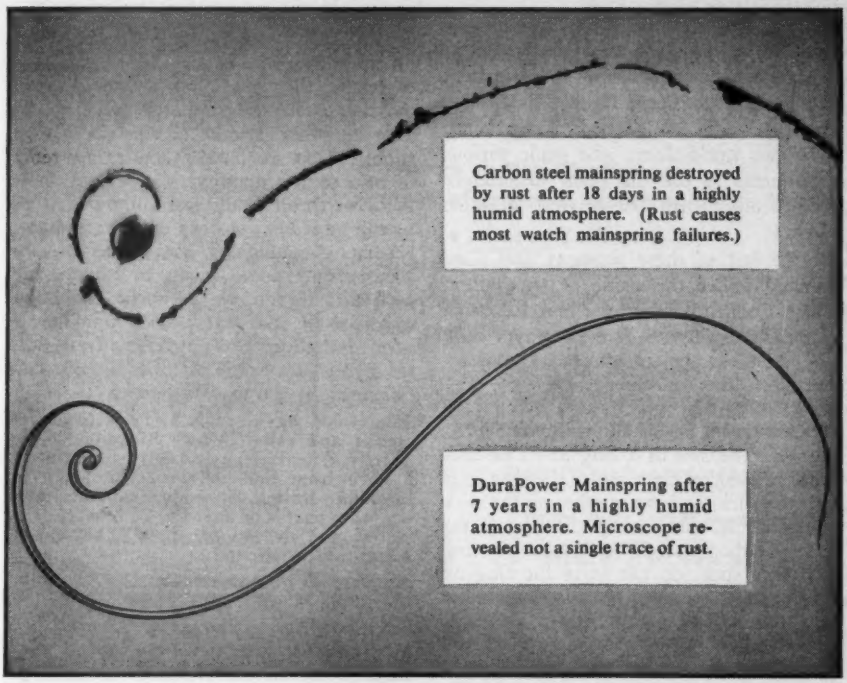
These parts were bought by the X-L Watch Company of New York, and I understand the X-L Watch Company assembled and furnished Masonic watch movements from their stock of parts when they received orders. The original Dudley watch has become quite a collector's item when it can be picked up, and usually sells for around $100.00. As in the skeleton glass back case, most of them were cased in by the Dudley factory when it was a going concern.

The following is a quotation from papers read by John Bowman at the Lancaster Horological Society in 1945: "An ambition to establish a watch factory in Lancaster apart from the Hamilton Company and its forerunners was the Dudley Watch Company. Mr. Dudley had been superintendent of the Hamilton Company, and somewhere around 1920 had conceived the idea that a watch he designed, with the movements, bridges, and cocks in the form of Masonic symbols could be sold in great numbers to the Masonic fraternity.

"He left the Hamilton Company's employ and started making watches on a very limited scale; soon, however, he succeeded in interesting businessmen in the possibilities of his idea and after a vigorous stock selling campaign in 1922, the stockholders met in February, 1923, to elect a board of directors.

"W. W. Dudley, John D. Wood, George W. Adams, A. J. Dudley, Charles Ledzelte, G. R. Miles, R. T. Norment, J. W. Gayley, C. B. Rost, and Mr. Sechrist were board members. A lot of ground was bought on southwest End Avenue and a well-designed building erected on it. Machines and tools were bought and built, and making parts of the watch was gotten under way with the usual miscalculations and delays of watch manufacturing enterprises.

"After some of the watches were at last ready for marketing, the buyer response was found to be disappointing, then followed a series of reorganizations, experi-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ments in selling methods and changes in management personnel with no permanent betterment of business results. Finally, at a receiver's sale, the property was brought in by two stockholders who made various experiments to use the plant to produce watches other than the original Masonic watches.

"In the last of these attempts, the plant operated under the name of the Fulton Watch Company, making a bracelet watch of cheap construction of a Swiss type with pin pallet escapement which was not acceptable to the American trade."

HWR: What do the steps on a ring stick represent beside the ring number?

Answer: The size of a ring or its number is determined by the distance the ring goes onto the stick, and the number on the stick represents the diameter of the ring at the center of the band. When gauging a ring on a ring stick, do not force the ring on tightly, but to a snug fit. No fingers are truly round, and many fingers are more nearly square. While the gauge gives you the ring size by number, they are graduated in units by .032-inch. Ring size number one gauges .458 inches in diameter, and the large size, 13½ measures .890 inches in diameter.

All intermediate full sizes vary by .032 inches.

HTM: I have noticed many wrist watches both with flat and breguet hairsprings, have a tendency to run slow in the stem-up position even though I have poised the balance carefully. What would cause this? I should also like to know how long it is safe to use a bottle of watch oil before it becomes spoiled.

Answer: You say the watch runs slow in stem-up position; then it evidently must gain time with stem down, which might indicate that there may be some interference between the guard pin and the roller or the jewel pin and the fork slot which may be cutting down the motion, giving a faster rate. It might also be that the hairspring is not properly circled around the collet; this would create an out-of-poise error.

It may be possible that you have some rough balance hole jewels, one side of the hole being rough and the other half polished. This would cause a change in motion of balance and change in the rates. Possibly the watch may be magnetized, especially the lever, which would have more atraction to the roller in one position than the other. The balance pivots may be slightly bent or out of round. In reply to your second question, the ordinary bottle of watch oil should last to the last drop, providing it has not been exposed to light, become contaminated with foreign substances, or exposed to air by leaving the cork off. If you are in doubt about the condition of your watch oil it would be a good deal cheaper to purchase a fresh bottle of oil, as a bottle of oil is usually sufficient to oil 300 to 400 watches.

EG: I am having trouble with pallet stones and roller jewels becoming loose shortly after I clean and deliver the watch. I have been told to clean the parts in cleaning solution, rinse in warm water and lay the parts in alcohol to absorb the water, and dry in sawdust. What am I doing that is wrong?

Answer: There are several ways of cleaning a watch and your procedure should bring good results; however, I am inclined to think that you may be allowing your parts to lay in the cleaning solution too long; then some solutions will attack shellac. Then again, you may be leaving the parts in alcohol too long; alcohol will dissolve shellac very quickly. When using alcohol, a very quick dip is sufficient, then dry the parts in fine warm boxwood sawdust. With our modern cleaning machines, cleaning solutions and dryers, there is very little trouble experienced with loose roller jewels and pallet stones. I might suggest that you look into the latter methods.

STA: I have taken in an electric clock for repair made by the Bulle Clock Company. It is an imported clock and I am unable to procure the same kind of dry cells as the old ones which have deteriorated. Can you advise if these special cells are to be had in this country?

Answer: Your writer has had several of these electric clocks and finds that you can use two Eveready flashlight cells. They are round, 1¼ inches in diameter and 2¼ inches long, and have ample pulling power to drive your clock.

AST: How do you explain that when rounding the end of a balance pivot the watch will run slower? I always find the balance takes a better motion.

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Answer: If the pivot is perfectly flat and has full contact for its full radius, the friction occurs at the extreme diameter of the pivot and will have the effect of shortening the arc, causing the balance to make its excursion in a little quicker time. When you round the end of the pivot, you move the friction from the outer edge of the pivot to the center where the friction is not so effective, thus allowing the balance to take what you call "a good motion," but it is also taking a little longer time to make its excursion, thus showing a slower rate. If the watch has an isochonal hairspring, the effect of this motion will not show up in timekeeping. If the hairspring is isochronal, it will control the time of the balance as the arcs vary.

GF: I have a lot of cheap modernistic jewelry brought in for repairs, the kind one cannot hard solder, so I must resort to the soft solder method, but every time I attempt to solf solder it seems I get all messed up and the jewelry is not presentable. Can you offer some suggestions as to how to do such jobs?

Answer: First, thoroughly clean the surfaces to be joined, then moisten the parts in soft soldering solution, then having joined them together, lay a small piece of solder on the joints and hold over your lamp or direct the heat on it with your blowpipe until fusion is apparent. Withdraw them from the blaze immediately since too much heat will render the solder brittle and unsatisfactory. When the parts to be joined can be made to spring or press against each other, it is best to place a thin piece of solder between them before exposing to the heat. When the smooth surfaces are to be soldered one upon the other, you may make an excellent job by moistening them with the fluid and then, having placed a sheet of tin foil between them, hold them pressed firmly together over your lamp until the foil melts. If the surface is fitted nicely, a joint may be made in this way so close as to be almost imperceptible. The bright looking lead which comes as a lining for tea boxes is better than tin foil. The following is a method for coloring soft solder so that when it is used for uniting brass, the color may be about the same: First prepare a solution of sulphate of copper blue stone in water and apply some of this on the end of a stick to the solder. On touching it then

with an iron or steel wire, it becomes coppered, and by repeating the experiment, the deposit of copper may be made thicker or darker. To give the solder a yellow color, mix one part of saturated solution of sulphate of zinc and two of sulphate of copper, then apply this to the coppered spot and rub it with a zinc rod. The color can be still further improved by applying gilt powder and polishing. On gold jewelry or colored gold, the solder is first coppered as above, then a thin coat of gum or isinglass solution is laid on and bronze powder dusted on it, making a surface which can be polished smooth and brilliant after the gum is dry.

WDM: I have seen many high grade watches which have train wheels that appear as solid gold, but on close examination I find there is a thin layer of gold on base metal, similar to gold filled jewelry or watch cases. Do they make wheels of solid gold?

Answer: A thin layer of gold is applied for appearance's sake on account of its fine finish and attractive color. If the wheels are made of solid gold, too much adhesion occurs between the gold tooth and the pinion leaf, so to avoid this adhesion the wheel is made of hard brass, having a thin gold plate on the upper finished side of the wheel.

FS: Is it o. k. to oil the fork slot and the roller jewel after cleaning the watch?

Answer: Putting oil on the fork slot and roller jewel will only create trouble—if this were advantageous or proper, all the watch manufacturers would do so. Our advice is to see that the jewel is perfectly clean, the fork slot smooth and polished and left in that manner. In later years some of our clock companies manufacturing lever clocks where there was a steel pin and brass fork, resorted to slight lubrication of the pin. This was done by saturating a cork or pithwood with oil and then pressing the impulse pin into the cork, leaving a very thin film of lubrication which improved the motion of the clock.

GFC: Should the wheels, studs and springs on a calendar watch be oiled and, if so, how much?

Answer: The posts the wheels ride on and the underside of the wheels are left dry, however, slight lubrication to the tips of the teeth or tips of the retaining springs that come in contact with the wheel teeth is advantageous.

DH: Can gold wire be hardened after hard soldering it?

Answer: There is no process known to harden gold wire after it has become annealed except by some mode of compression such as burnishing, rolling or hammering, thus making the gold wire more compact.

HRH: Can you tell me when oil wells were first used in clock plates?

Answer: There is nothing definite in my library pertaining to oil wells, however, I believe these oil wells or sinks came about due to the thick plates that were used in the early clocks, as pivots in the early clocks were of normal length and did not project through the plates. In order that the oil might reach the pivots, a countersink was made which, naturally, formed an oil well. In the ordinary clocks having thin plates, if wells were to be sunk, it would leave the plates too thin, interfering with the bearing surfaces and wearing qualities of the clock.

PJ: I am interested in knowing just who invented the watchmaker's lathe chucks we use today.

Answer: In the early days of watchmaking when production became a factor, Charles Moseley who was employed by the Elgin National Watch Company, invented what is known as the spring collet. He applied this collet to the automatic screw machines which speeded production and revolutionized the screw machine to our modern automatics. The chuck was then applied to the watchmaker's lathe and revolutionized the lathe from the old method of using a four-jawed chuck or scroll chuck to hold the work. The chucks, as we have them today, eliminated the necessity of cementing work into brass chucks for turning small watch parts.

CB: What should the jeweler furnish for his watchmaker? I am a new watchmaker just out of school and before I invest in more tools I would like to know what my future employer furnishes.

Answer: In a regularly equipped shop the employer should furnish the bench, lights, chair, the cleaning machine, demagnetizer, friction jeweling tool and, if he desires, a timing machine. The watchmaker is expected to furnish his small hand tools, staking tool, a lathe and an assortment of chucks and an electric motor for driving the lathe.

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We are enclosing a dial refinishing job. Ship and invoice us for one thousand Silbert Watch Repair Tags at the special price of $2.80.

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Watchmaker's Contest

A.H.&J. Reader Ideas on Practical Bench Methods, Experiences or Tools.

A.H.&J. is pleased to announce the following winners of its August Watchmakers' Contest:

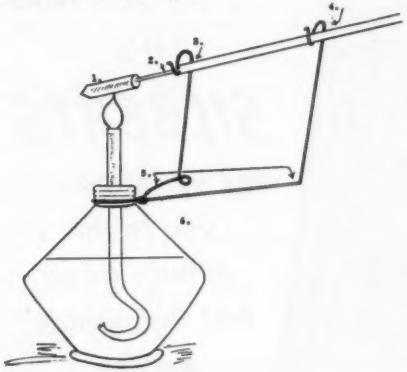
First prize: Fitrite assortment #178A Chronograph staffs goes to Mr. Ed Casper, Blueberry Lane, Monroe, Connecticut, for his 'Waterproof Case Opener', Contest Entry #25.

Second prize: Algren spring bar set, 72 assorted sizes goes to Mr. Douglas F. Snook, 1244 Ward Street, Martinez, California, for his 'Pegwood Knife or Pin Saw Using 'Pal' Injector Blades,' Contest Entry #26.

Third prize: Parts cleaning holder, cleaning brush and movement holder goes to Mr. W. R. Burtner, 2902 S.E. 92nd Avenue, Portland 6, Oregon, for his 'Removing Cap Jewel from Incabloc Setting', Contest Entry #28.

MIDGET SOFT-SOLDERING COPPER AND HOLDER

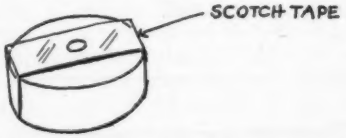
CONTEST ENTRY #29



1. 3/16" soldering copper.
2. 1/16" from copper to shoulder diameter to keep heat from handle.
3 and 4. Loops made in 1/16" copper wire holder.
5. 1/16" wire is looped around alcohol lamp, and is adjusted to hold soldering copper at proper distance from alcohol flame.
6. Alcohol lamp.

SEPARATING INCABLOC JEWELS

CONTEST ENTRY # 30

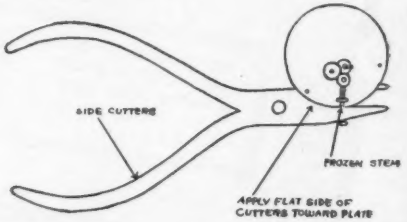


I should like to enter the little tool which we keep in our bench for separating Incabloc jewels in the Watchmakers' Contest. This tool consists of a round block of wood about a half an inch thick with a piece of scotch tape, sticky side up, completely encircling the block.

To use this article we merely touch the Incabloc jewels to the scotch tape upside down, and the cap sticks to separate the jewels.

REMOVING RUSTY STEM

CONTEST ENTRY #31



As we all know, many times the repairman receives a watch to be repaired which has a frozen stem caused by perspiration or immersion in water. I have found the job of removing the stem very difficult, but have discovered a way that will work without harm to the plates.

First remove all wheels and plates except the bottom plate that the stem and gears are in, and are rusty and frozen, and apply rust remover. Let soak, then rinse in cleaning rinse, then oil the gears and stem heavily, and let this soak. Insert your side cutters between the crown and the side of the plate as if you were going to cut the stem in two. Apply a little pressure and you will see them come right out.

HOME-MADE REGULATOR

CONTEST ENTRY #32

Sometime ago I received a Dueber Hampden pocket watch for repair, the regulator of which was missing. Aside from that the movement seemed in fair condition.

Thinking it might be impossible to obtain one, I decided to make one. This particular watch was one with the star wheel and pinion for moving the regulator, which is a rack and lever arrangement. The main obstacle was to cut the fine teeth on the rack, for which I had no cutter. After some thought, I proceeded to do the work as follows:

First, cut a piece of oil hardening steel 5/16 inches wide, tapered to 1/4 inch which was the width of the rack, and a little longer than the total length of the regulator. Measure from the dedendum of the star pinion to the center of the balance hole jewel and make a fine punch mark.

With dividers, using the punch mark as a center, strike off the arc of the rack. Also strike off two arcs to locate the regulator pins, taking the measurements from the jewel hole to the hairspring a short distance from the stud. Tin a cement brass and also the piece of steel, and place the two in a lathe with a male center in the tail stock, center the piece of steel with the aid of the punch mark, and apply heat enough to join the cement brass and steel.

With the slide rest, cut the arc of the rack—next, bore and chamfer the hole for the regulator dome. Remove the steel from the cement brass, placing a soft piece of wood either side of the steel, and clamp it in the vise, rack end uppermost. With a fine single cut file rub it across the steel in a draw filing motion. Keep the teeth of the file at right angles to the work piece, starting at one end of the rack and gradually following the curvature of the rack piece.

When the teeth have been formed sufficient to engage the star pinion, remove the piece, put it on the balance cock and screw on the dome to hold it. Center the rack with the pinion and mark off the projection for the regulator pins. Commencing nicely clear of the balance cock on the stud side, scribe two lines, bisecting the arcs previously scribed for the regulator pins. Finish laying out of rest of the regulator, and file to shape.

Drill the holes for the regulator pins, taking measurements from the jewel hole to the overcoil, then, laying the regulator on another piece of steel, to minimize warping, heat the two to a cherry red and quench in water or oil, depending on the type of steel used. Grind and polish. Split or saw, with a carborundum slitting saw, the dome hole, to give it gripping power, which should be one or two hundreths of a millimeter smaller than the dome. Rivet and shape your regulator pin, and the job is done.

If, through miscalculation, the regulator is a bit short of engagement with the star wheel teeth, it may be stretched before hardening by laying it on an anvil and striking the arm a few light blows with a ball peen hammer or round-faced punch. It is advisable to make it too short, rather than too long, using the stretching technique to bring it to proper length.

WINDING AND SETTING DEVICE

CONTEST ENTRY #33

I should like to enter a device for winding and setting the split stem type movement when out of the case in the Watchmakers' Contest. During the assembling and lubrication of the split stem type movement it becomes necessary to engage the winding and setting parts in the usual routine manner, i.e., greasing setting parts, trying cannon pinion tightness, freedom of train, motion, etc.

An ordinary large opening crown fitted with a crown neck and piece of tubing will serve the purpose very well by simply snapping it on and off as desired.

1-2-3 winners among this month's entries will win the following prizes:

First prize: One Arnold Universal case opening wrench and bench block.

Second prize: 12-piece lathe set consisting of grinders, buffs, brushes and end mills, plus bench block.

Third prize: Parts cleaning holder, cleaning brush and movement holder.

CLOCKWISE...*and*...OTHERWISE

By J. E. COLEMAN

OTHERWISE

Last month we ran a "What's Zit"?—wouldn't a "When's Zit"? be better for this month? This generation takes air travel for granted; we see lots of novelty clocks (especially electrics) built with an airplane case or mounted in a prop hub, etc.—ever stop to wonder when the first one was manufactured? We did, and set about to search old trade journals for the first one advertised and here it is.

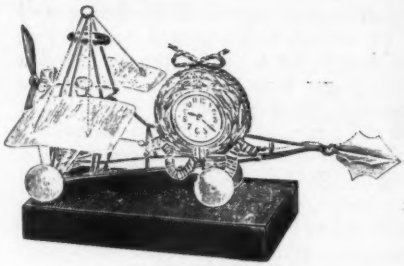
They even spelled it differently back in those days—want to guess the year and month this novelty came out? As suggested, jot your guess on the margin of this page, do it mentally, or better still send us a card and look for the answer, first item in the November *Otherwise.*

* * *

It is very unusual for us to start an *Otherwise* without either a new tool or a new book—this month nary a one. Les Collins of Burton M. Reid Sons, Inc., wrote a couple of weeks back that he would get me some dope on the new clock bushing tool they have, but to date it hasn't come in.

I understand most businesses call any dropping off in activity along about this time of year the "summer slump"—well, maybe *Otherwise* has just had its "summer slump." There is no slump in cooperation; lots of good letters and many practical suggestions, bits of pertinent information, etc. In view of the many inquiries relative to counting clock trains, we especially appreciate a letter from Joseph R. Smith, Box 137, Crestline, California, as follows:

Dear Mr. Coleman:



No. 702 AEROPLANE MINIATURE REPRODUCTION. PROPELLERS AND BODY IN BRASS. Planes and operator in White Metal. One-day movement, ½-inch dial. Base of black marble 4¼ in. high, 7 in. long.

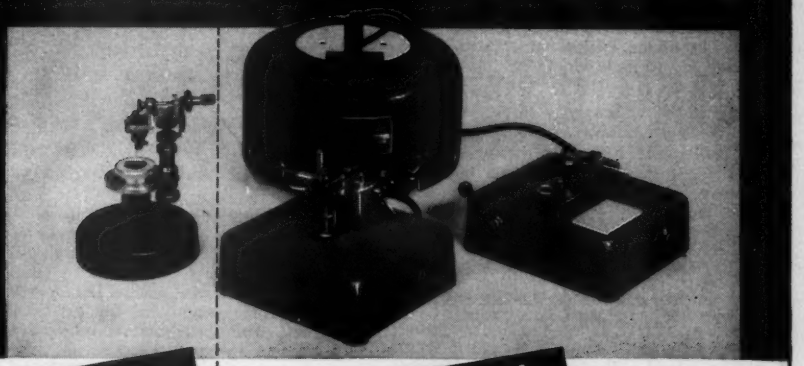
"WHEN ZIT?"

I noticed the letter from Mr. Anthony in your column in the A. H. & J. asking for a rule for calculating a train with an idle center drive. I have developed a formula for figuring these trains, and also found that in figuring these trains in the generally accepted way, there were numerous fractions involved and this made it complicated. Maybe you have also used this method, anyway I present it for what it might be worth. I have met lots of clockmakers who never thought of using such a formula.

Referring to the sketch sent by Mr. Anthony, the center idle pinion and the third pinion of 8 leaves are both meshed with the same wheel, i.e., the second wheel, so each time the idle

Mr. Coleman invites your questions. If your question requires a direct answer, please enclose a self-addressed, stamped envelope. It is impossible through correspondence to give valuations of antique timepieces; questions of this nature cannot be answered

Amazing development in hairspring vibrating!



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- ✓ **Every hairspring is returned in beat, properly timed, leveled, centered and attached to the bridge. This is made possible through our patented method . . . VIBRA PAC.**
- ✓ **Every hairspring is unconditionally guaranteed. A new spring FREE, if spoiled for any reason.**
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pinion moves forward one tooth, the third pinion also moves forward one tooth. This effect is the same as though the idle pinion was meshed to the third pinion, hence we can eliminate the second wheel in the calculations as though we had the idle pinion meshed with the third pinion. Then the formula would be $\frac{26x40x40x62}{8x7x8}$ which figures 95.95 beats per minute or practically 96 beats per minute.

You will notice I doubled the escape wheel teeth in the formula. This formula makes the calculation as simple as if the center wheel were in the train.

JOSEPH R. SMITH

* * *

Couple of fine letters from England—besides getting some facts on the clock for James W. Cartwright, we've introduced him to a new word or term which it seems they are not familiar with over there—"rain-check." The letter from Mr. Cartwright follows:

Dear Mr. Coleman:

First of all, thank you very much for your articles on the "statue clock." I certainly understand what "rain-checks" mean now, and you have scored full marks. I have written to Mr. Goldsmith and thanked him very much for his letter in the June issue of the C. & O. and am looking forward to his reply.

If the photos are any good to you for your files, please keep them. I would very much like a copy of the A. H. & J. for August, 1941, if one could be obtained. Have you any information on the second clock I wrote about engraved "Saint Martin, Paris"?

If I can be of assistance to the C. & O. in your inquiries at any time on this side of the Atlantic, I shall be very pleased to do so.

JAMES W. CARTWRIGHT

5 Church Street
Alford, Lincs
England

* * *

From Vincent Topham, Ashton-under-Lyne, England, comes this letter in the true craftsman spirit:

Dear Mr. Coleman:

I have neither the time or the inclination to intrude on the domain of others, but in this case I consider it a duty. To begin with, I have received a lot of information, interest and pleasure in reading C. & O.—the following are facts: Joseph Johnson, watchmaker, was in business at 87 Brownlow Hill, Liverpool, about 1850; Arthur Ingram (sic) clockmaker, 3 Clerkenwell Road, 1887; Thomas Edmund Rhodes. Rhodes, 19 Highgate, Kendal, 1885. I sold the three train musical skeleton clock illustrated on page 72, June edition A. H. & J., with center trip—an exceptionally fine clock; owner, Mr. Myers. 7 tuner. I hope these details will be of interest to you.

VINCENT TOPHAM

Mr. Topham is an antiquarian horologist and authority of international repute—it is certainly good to have him say he is a reader of C. & O.

* * *

We are particularly interested in this letter from V. V. Kemp, 2107 Pacific Avenue, Long Beach 6, California, in which he enclosed some sixteen photos:

Dear Mr. Coleman:

I am sending you a few pictures of some of the jobs we have done. This, we believe, is the answer to many a clockmaker's headache, especially the bi-synchronous Hammond (the $3.98, 20 years ago mantle clock); the French clock without visible pendulum that has been mutilated; one prize photo shows a Waterbury ship's bell movement where the escapement was ruined beyond repair, the strike mainspring barrel cover was ruined, as you can see the repair on it. Now these clocks are a useful modern timepiece with all of the inside aspects of grandma's old clock.

This has been our answer to satisfactory time which makes our customers very happy. The photo showing the dial and case of a 4-jewel Waterbury in a large marble unit with barometer and temperature gauge, now the customer is very happy, as I am, with the Ansonia chime which is mine.

The two pictures of the lathes are of Herman Boehmer and his bench. The lathes are Derbyshire magnus—one is the electric and it on these that this work was done.

V. V. KEMP

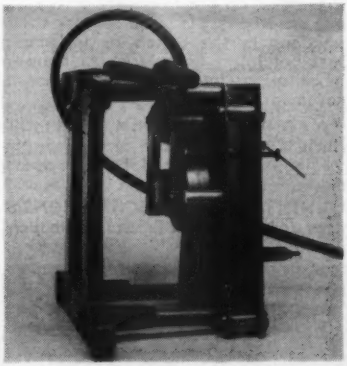

Figure 1

From all evidence Mr. Kemp is quite versatile when it comes to applying the synchronous motor to old clocks. In figure number one, a Telechron motor has been applied to a Seth Thomas 77-B (80-beat regulator); in figure number two, an old

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Figure 2

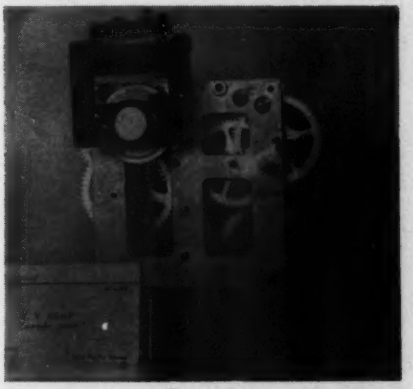


Figure 3

English grandfather movement has been completely electrified (both time and strike) by driving the time train with a Hansen 600 series motor and the strike train by a Hayden motor.

The third photo is the common garden variety of eight-day American mantle movement with a Telechron motor driving the time train; the strike train was left intact. It is wound weekly and strikes exactly as if the time train was propelled by its original mainspring.

Personally we've never been able to whip up enthusiasm for substituting a synchronous motor, but on the insistence of the customer, we've done it a few times when we could not talk them into a restoration job. Successful department stores insist

that "the customer is always right," but my experience has been that the customer is seldom right.

Why should Mrs. John Doe go to an auction and bid her socks off for some clock simply because it is said to be an "antique," then immediately have it modernized? This sort of doing reminds me of the story of the fellow who wanted to take a plane ride, but keep one foot on the ground. Let's either ride or stand on both feet!

If Mrs. Doe wants an electric clock, she ought to hie down to a reliable jeweler's and buy one. If she wants an antique, she ought to buy same, but keep it so by paying some clockmaker with equipment and ability to restore it to its original mechanical condition. This is just one man's opinion. Friend Kemp seems to be doing a good job of what he attempts—maybe he is making his customers happier than I do mine. After all, we must have those groceries. We'd like to hear from him and from some of our readers on the question: "To Electrify or Not to Electrify?"

J. & J.

CLOCKWISE

Dear Mr. Coleman:

As a subscriber to the A. H. & J. for several years, I value it very much, especially the Clockwise and Otherwise discussions. I have a Lewis perpetual calendar clock made by Jerome, and some of the parts are missing that connect the time movement to the calendar movement. The space between the face arbors is 10 inches, the time movement and the calendar are in good running order.

I need the parts that connect the two, and am at a loss to know what they are to get the clock to running. Can you give any instructions as to what I need, or is the above too vague to understand?

GEORGE H. STEVENS

Box 14
Milton, Wisconsin

Dear Mr. Stevens:

We appreciate your remarks about the column; we don't always hit a home-run, in fact, we sometimes strike out, but we try to stand up and swing.

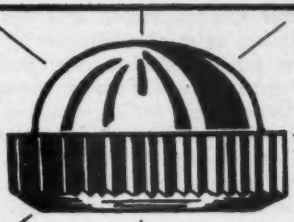
It is difficult to pin-point specific directions with no more definite data than that your letter gives. Yours is the first Jerome clock we've heard of being equipped with a Lewis calendar. Does it all look original? In other words, could this be an adaptation by some workman who simply put a Lewis calendar on a Jerome clock?

Lewis calendars were built under three patents: February 4, 1862, September 7, 1862, and December 29, 1868. No. 39883 of September 7, 1862 was by William W. Carter and assigned to Mr. Lewis; the other two were Mr. Lewis' own. The first, No. 34341, February 4, 1862 is the basic design, the other two being minor changes.

The Lewis calendar differs from that used in the Ithaca and Fashion in that it does not use drums, nor does it designate the month by name. Most Lewis calendars had a small hand mounted concentrically with the hour and minute (just under the hour hand) which indicated the day of the week, the seven days being spaced just inside the hour circle. Located under the clock's dial was a second round dial which by a pointer indicated only the day of the month.

In practically all Lewis devices we are

Lewis Calendar Clock



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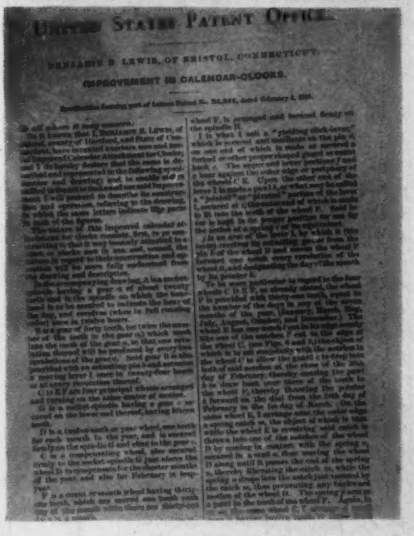
familiar with the week day hand being fitted to a pipe which rides loosely over the hour pipe and attached to the back of this pipe is a seven-pointed star wheel. Located somewhere on the front plate is a post over which fits a gear wheel and at the base of the hour pipe (next to the front plate) is another pinion which drives this gear wheel in the ratio of two to one, i.e. your hour pipe revolves twice in 24 hours and this gear wheel one rev. in 24 hours.

Near the outer edge of this gear wheel is a pin, which pin engages the seven-point star wheel and thus moves the week day hand forward once every 24 hours. You can readily see that this action is relatively slow—it must be set so as to begin about 11:00 p.m. and it will have the hand shifted, one day, in about two hours' run, that is, complete the action about an hour past midnight.

To actuate the day of month hand on the lower dial merely requires a trip once per each 24 hours. A thin narrow strip of brass with a hole drilled in its top end to fit the aforementioned pin is hung on that pin. The bottom end of this strip has



UNITED STATES PATENT OFFICE.

BENJAMIN B. LEWIS, OF BRISTOL, CONNECTICUT.

IMPROVEMENT IN CALENDAR-CLOCKS.

Lewis' Patent

a slot cut in it, and when the lower door (with the month calendar in it) is closed, the trigger of the month mechanism goes into this slot.

By having this brass strip work in the slot cut into the wood of the case dividing the two dials, the turning of the one per 24-hour gear wheel with the pin imparts an up and down motion to it. Thus at about the same time the pin begins to move the weekday hand from Monday to Tuesday around 11:00 p.m., it (this same pin) has lifted the brass strip so that it is also pulling the day of the month trigger up and is tripping the month date from the 14th to the 15th.

I hope that when you again examine your clock you will find the pinion atop the hour pipe and also the gear wheel, then your problem will be a simple one, of only making the strip and adjusting it to length. However, if either the pinion or gear, or both, are missing, it won't be too big a job since you say the calendar mechanism is in order. We trust that this is clear—in case it isn't just make a pencil sketch and indicate what you wish.

J. E. C.

Dear Mr. Coleman:

Thanks very much for your recent help. I surely do appreciate your column. We have a Seth Thomas 'Legacy' clock for repair which has a No. 124 movement. After taking the movement down, we noticed that the time barrel arbor hole is not concentric with the barrel—by a long shot.

The time main wheel is smaller in diameter than the time barrel too, but because of the eccentricity of the arbor hole, the teeth extend far enough past the barrel to engage with the next wheel. The chime and the time trains have the same size barrels and apparently the two springs are the same length. The strike barrel is smaller.

Is it "kosher" to have the main arbor out of center with the barrel? Too, it seems to us that the time train in the No. 124 had the smaller barrel? Or haven't we been too observing?

JAMES O. KNUDTSON

P. O. Box 471
Roseburg, Oregon

Dear Mr. Knudtson:

What you are referring to as a 'barrel' in the No. 124 S. T. chime clock is not a barrel at all, but rather a spring box. To all intents and purposes it only confines the spring as it unwinds, just the same as the pins attached to the plate do in the general run of open spring American clocks.

Since it is a box and not a barrel, there is no absolute necessity for it being concentric with the winding arbor. In the earlier model No. 124 chime, the mainspring boxes were mounted concentric (or nearly so) with the arbor. Now, since the engineers at S. T. saw fit to make this change, we take it that they must have seen no necessity for allowing (or making) the spring develop to one side.

If you have noted the pins mentioned above, usually two or three, they are never set equally distant from the arbor, but are placed so as to prevent the unwinding spring from developing against another arbor, the strike hammer, etc.

In general, in timepieces you have two types of barrels—1. the going barrel; in this type the driving gear is cut on the barrel and it turns (goes) as the piece runs—the arbor turns only when the spring is being wound. 2. the motor barrel; on this type the mainwheel is separate from the barrel and turns with the arbor as the piece runs, the barrel remaining stationary and turning only when the spring is being wound. Here we note that both types' barrel turn at some time or other; a spring box never turns at any time—it is riveted fast to the plate.

J. E. C.

Dear Mr. Coleman:

I have for repair a battery clock that looks similar to the 400-day clock; the name on the dial is 'Tiffany Never-wind, Buffalo, New York. Patented March 8, 1904.

The battery is missing and I have no way of knowing the voltage that the clock requires. If you have this information it would be appreciated. The battery fits in the base of the clock, and the space measures approximately 3¾" x 11½".

JACK T. WAY

1130 North First Street
Jackson, Michigan

Dear Mr. Way:

The Tiffany Never-wind battery clock operates on 4½ volts. The standard or D size flashlight cell is approximately 1¼

inches in diameter by 2¼ inches high.

You can easily make up a satisfactory battery for the Never-wind by taping up three of these cells and connecting them in series. When soldering connections, make sure your iron is hot and do it with the quickest touch possible so as to heat the battery as little as possible. The three taped cells may then be placed in a cardboard box (you can make it) and the two end connections should be thin strips of copper or brass brought out the end of the box and bent down the side to contact the strips in the clock.

The Burgess Battery Company is making a battery for this clock; their stock number is 332S, and your local battery dealer or radio supply house should be able to supply it from stock. If not, he can order it for you. He won't find the 332S listed in his latest Burgess catalog, but they are making it and will fill his order.

J. E. C.

Dear Mr. Coleman:

Can you tell me where I can get a Hammond synchronous motor, 60 cycle type C for electric chapel chimes No. 1 - 313, electric 3-rod chimes, or is there another motor that will run this kind of clock?

PAUL J. THYLEN

172 Market Street
Sangerties, New York

Dear Mr. Thylen:

The type C Hammond motor is no longer available—has been out for quite awhile. Write William A. Phelps, 4601½ Glenway Avenue, Cincinnati 5, Ohio. He stocks a self-starting, synchronous motor specially designed to replace the type C; this is a complete unit with enclosed coil and requires only to tap two holes to attach it.

J. E. C.

Dear Mr. Coleman:

As I have read your Clockwise and Otherwise for some time and finding it very helpful in the clock field, I was wondering if you would answer a few questions for me. For a long time I have wanted to build an 8-day, key wind wooden movement grandfather clock, and on building the movement, I find it is running far too fast—10 minutes an hour too fast.

I would appreciate it a great deal if you

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would show me where I made my mistake in the gear train, and what changes to make to slow it up. I am sending you a picture of my gear train; I would also like to half the pendulum about 38" to 42" in length.

W. R. LATIMER

526 Eastern Avenue
Bellefontaine, Ohio

Dear Mr. Latimer:

Train problems are relatively simple, but despite that fact they can often be most vexing. Your train as indicated by your sketch is geared way too low, and would require a much longer pendulum to bring it to time.

Let's simplify the problem as much as possible: first, you desire a "Royal" or seconds pendulum, second, we know that the active length of a seconds pendulum is 39.14 inches (active length is from point of suspension to center of gravity—if you had your pendulum off and laid it across a knife blade where it balanced, that would be the center of gravity, thus seconds pendulums are often 42 to 45 inches in over-all length depending on the weight of the rod in proportion to that of the ball).

Now, the reason for a 30-tooth escape wheel in a seconds beating clock is for a seconds hand, i.e., each tooth causes two beats or ticks—2 x 30 equals 60 seconds, or one complete revolution of the escape wheel arbor every sixty beats. The center post, or center arbor (on which is mounted the minute hand) must revolve once per hour, thus the ratio between the center and escape arbors will of necessity have to be 60 to one since we have sixty minutes in the hour.

In the sketch of your clock you show only one wheel between the center wheel and the escape wheel, so your problem is to make that center wheel turn the escape wheel 60 revolutions every time it (center) turns one. Here it is evident that the center pinion and the main wheel have no direct concern in this problem of timing. Take a close look at your drawing—the third wheel already drives the escape 6 to 1 (the 48 teeth will revolve the 8 leaf escape pinion six times) thus the center will have to drive the third 10 times in order that the third will drive the escape 60 times.

Therefore, any ten to one ratio between the center and third will give you the correct train. Inasmuch as you already have an 8 leaf pinion on the third arbor, why not make the center wheel with 80 teeth? Proof: $\frac{80 \times 48 \times 30 \times 2}{8 \times 8} = \frac{230{,}400}{64} = 3{,}600$ beats per hour; 3,600 beats divided by 60 minutes equals 60 beats per minute. This was figuring the clock to the pendulum.

Repairmen often have to figure the pendulum to the clock when clocks come in minus a pendulum. Here you calculate the train (from the one rev. per hour of center post to escape wheel), take the number of times the escape wheel turns times its teeth times 2 (2 beats per tooth) and you have the required number of beats to make the clock turn exactly one hour (one rev. of the center). See the example on the chart I am sending to you.

This clockmaster knew he wanted a pendulum to beat 90 times per minute; he squared the time 90 x 90, squared the length of the seconds pendulum 39.2 inches, divided the 8,100 into 141.120 inches and got 14.42 inches. Trusting that this answers your question and that you will write us again when you have a clock problem.

J. E. C.

Dear Mr. Coleman:

I have in for repairs a Seth Thomas 8-day, hour strike wall clock that is giving me much trouble. You have helped me once before and I am very grateful, in fact, your C. & O. column is always very informative.

This clock runs ten minutes slow per hour. The movement seems to be original in every way, although when it was brought to me the pendulum bob was affixed about 1/3 up the distance of the pendulum rod (wood), but the rod does look original with the adjusting nut fixed to the bottom.

After putting the movement in order and returning the bob to its correct position I timed the seconds hand (direct to the escape wheel) and it makes 80 beats per minute, one perfect rpm, but the clock runs slow, why? This seems to be a 3/4 beat pendulum (22 inches long), escape

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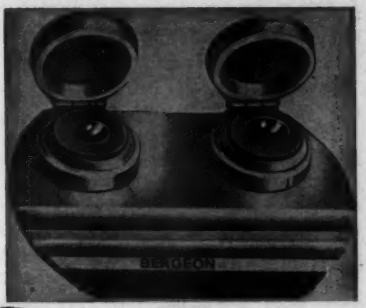

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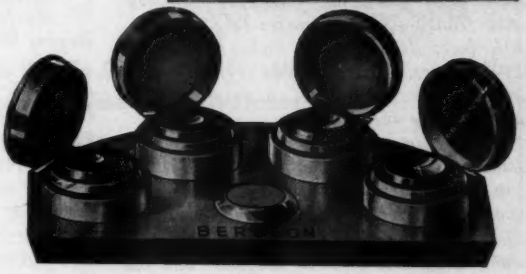

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wheel has 40 teeth, pinion (lantern), 8, next wheel 90 and 7, next 84 and 8—I did not count the main wheel.

I repair all makes of clocks and enjoy them all (just finished an old 400-day that was a "stinker"). Visited Clock Manor in July and really enjoyed it; got to see the Empress—they tell me it is to be returned soon. Hope you can help me. Regards to you and Jan.

THOMAS J. MAY

890 Laurel Street
San Carlos, California

Dear Mr. May:

We fear that you have made some error, or else haven't given us the complete data on this clock. Wall clocks that strike are a bit rare, especially if it is a long pendulum —is it possible someone has installed a regular striking clock in this wall case?

The 40-tooth escape wheel in a regular wall clock generally indicates an 80 beat (22 inch pendulum); it should be 90 beats to be an exact three-quarter beat. You state that the wheel driving the escape has 90 teeth and a 7 leaf pinion, the wheel driving it has 84 teeth and 8 leaves, thus: $\frac{90 \times 84}{7 \times 8} = \frac{7{,}560}{56} = 135$ revs. your escape arbor. 40 escape teeth times 135 revs. equals 5,400 teeth per one rev. of the 84 tooth wheel. 5,400 times 2 beats per tooth equals 10,800 beats per rev. of the 84. 10,800 beats per hour is 180 beats per minute; pendulum 4.3 inches long.

This calculation presumes the 84 wheel to be the hour wheel. If your hour wheel is auxiliary driven it could turn up almost anything, depending on which wheel drives it and what ratio. The 4.3 inch pendulum sounds like an ordinary mantel clock movement — please re-check your figures and give us a rough sketch showing the center and how driven.

To calculate the proper length pendulum for any clock one must know the required beats per minute — this you can determine by counting the train. That is, you wish to determine just how many escape wheel teeth past a fixed point in exactly one revolution of the hour post (wheel).

As each tooth makes two beats, multiply by two and the result is the number of

beats per hour. Divide by 60 for the number of beats per minute, square the number of beats per minute, square the known length of the pendulum beating seconds 39.2 inches and divide.

J. E. C.

Dear Mr. Coleman:

I am sending you three snapshots of a grandfather clock which was recently brought to me in the hope I could determine the age of it. As I am not at all familiar with antique clocks, or their repair, I am now turning to you for help.

I have not actually seen this clock, but have been given the following information: Make—Seth Thomas; case height—8½ feet; depth — 19 inches; width — 22⅜ inches. It has a second register and is an 8-day clock, however, it does not have any striking mechanism.

Each side of the case has two glass panels as shown in my first picture; the top piece (picture two) is not in place, as the height of the room will not permit it to be. In picture three you will note a small door to a closet built in the base, and the base is 30 inches wide. The pendulum is the mercury type, and the movement is run by weight as shown in picture one.

Any and all information you can give me concerning this clock will be greatly appreciated.

HOWARD T. BENNETT

P. O. Box 16
Waterboro, Maine

Dear Mr. Bennett:

While it is housed in a floor case, the clock indicated is more of a precision regulator than it is a grandfather clock in the generally accepted manner, as you say it does not strike.

It is my thought that they were sold more to banks, railway offices and to jewelers for store regulators than as a clock for the home. To pin-point the date of this clock one would have to have access to a file of old clock catalogs, and after years of intense effort, I am prepared to say that old clock catalogs are about the scarcest of all books. Our oldest Seth Thomas catalog is 1915, and it lists nine floor clocks, but precision type regulators with metal dial and mercury pendulum are not among them.

Regulators of this type were popular in the 1880's and 1890's and since they were not being made in 1915, they did not extend far into this century.

J. E. C.

Dear Mr. Coleman:

I have three watches that I would like to get some information on as to how old they are and the general history, also the names of collections of old watches. The following markings are contained in the three watches: National Watch Company, Culver, N2324; patent, Elgin, Ill.; American Watch Company, Waltham, Massachusetts, Safety Barrel, 5576582; L&N. W. R., John Walker, 68 Cornhill & 230 Regent Street, London, 7151.

WILLARD J. BROWN

Box 434
Port Chicago, California

Dear Mr. Brown:

The National Watch Company was organized at Elgin, Illinois in 1864 and became the Elgin National Watch Company in 1874. It is possible that your watch, that is, watches already engraved "National Watch Company" could have been finished up and sold after 1874; however, since they were up to serial number approximately 100,000 by 1870, I take it that your No. 2324 must have been made between 1864 and 1870.

Practically the same situation with the next piece—the American Watch Company was organized at Waltham, Massachusetts February 4, 1859 and became the American Waltham Watch Company in 1885. You designate the number of this piece in the five millions; an approximate scale shows that they reached the five million figure around 1895. Such scales of years as to serial numbers can only be approximate; often watches of lower numbers are made later than some of the higher numbers, depending on size, style, etc.

Baillie lists eleven John Walkers at London between 1632 and 1825 (date his listing ends), and none have the street addresses you indicate. If this piece is in its original case it is hall-marked, and if you will send us an accurate sketch or pencil rubbing of it, we can give you the date.

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A complete list of public collections would be a long one and one of private collectors would be much longer. Foremost among the public collections would be that of the Ford Foundation at Dearborn, Michigan, the James Arthur collection at New York University, another at the Metropolitan Museum in New York City, and the Packard collection at the Smithsonian Institution.

It is pure presumption on my part, but if you seek to dispose of these pieces to collectors, I'd suggest that you run a small advertisement in "The Mart," a publication of the National Association of Watch and Clock Collectors — address Bernard W. Brandt, Dutch Street, Montrose, New York.

J. E. C.

Dear Mr. Coleman:

We have a Seth Thomas glass-cased clock with imitation mercury pendulum, diameter of plates, 3⅝ inches, 8-day strike —hour and half hour. The barrels are secured to the rear plate, the intermediate wheel shaft protrudes through the rear plate and is attached to a strike wheel.

The intermediate wheel functions with the following wheel which has ten pegs that operate the hammer, the wheel and mainspring arbor have 56 teeth, the intermediate wheel has 72 teeth and a 12-leaf pinion. The striking wheel has eight lantern pinions, and the inside diameter of the barrel is 33.5 mm.

The inside diameter of the time barrel is 37.2 mm; the number of teeth on the mainspring arbor wheel is 68. The intermediate wheel has 68 teeth and 9 leaf pinions, the center shaft has 16 leaves in pinion, the depth of both barrels is fully ¾ inch. We would like two correct size mainsprings for this clock if Colorado Jewelers Supply or Clock Manor can supply. Please give us explanation and figures on how one selects the correct mainsprings.

EDGAR P. SCHMITT

614 West Twenty-First
Cheyenne, Wyoming

Dear Mr. Schmitt:

The clock you indicate must be one of their "Imperial" line. These are often called crystal cabinet clocks because of the four glass sides, and were popular from about the turn of the century up to about 1922.

Most were fitted with the No. 48 movement which takes a ¾ inch hole-end mainspring, .43 mm strength by 54 inches long.

While you note slight difference in measurement of the spring boxes (not barrel, as they are riveted fast to the plate), the same is generally used for both the strike and the time.

The mainspring rule for the barrel is: the spring should occupy ⅓, the arbor ⅓ of the barrel area, and the last ⅓ left to space. The second rule: the number of coils when run down subtracted from the number of coils when wound up will give the number of turns the barrel will make. The first was not specifically designed as to boxes, but the second applies equally to boxes as it does to barrels.

Now, 24 revs per day of the center-post times eight days equals 192 revs for the eight day run. By counting the train you can easily determine how many revs the center-post makes per one rev of your main wheel—divide this into 192 and you have the required number of revs of the main wheel to drive the clock for eight days. Chapter I entitled "The Mainspring" and chapter II entitled "Calculation of the Train" of Higginbotham's "Precision Time Measures" covers this fully (A. H. & J. Book Department, $4.50 plus 8c postage).

J. E. C.

Dear Mr. Coleman:

I am writing you regarding a Seth Thomas Kingsbury model chime, S. T. No. 124 chime. This clock runs a full eight days, but the train on the quarter and half hour will not chime or strike at all. Have you any advice to offer on making the clock chime and strike?

R. H. SCHICK

3709 Chestnut Avenue
Kansas City, Missouri

Dear Mr. Schick:

Since the hour strike of the Seth Thomas No. 124 Westminster chime clock is tripped by the chime train, any time the chime train fails to function there is nothing to release the strike and it always remains silent. With no more to go on than just the make and model of this clock, it is going to be difficult to actually pin-point your trouble.

These movements come equipped with an automatic chime corrector, which device very often gives trouble to those not fully familiar with it. Correction is accomplished by having a much longer lift for the fourth quarter stroke—you will note on the center-post a four-legged lift, three legs being the same length and the fourth being much longer—this long lift will point straight up when the minute hand points to XII.

Now, on the third arbor of the chime train affixed by a set-screw just in front of the front plate is a double locking disc; note that the front disc has four notches, one to stop the chime at the end of each quarter and the back disc has only one notch. On completion of the third quarter chime operation, the chime train locks in the one deep notch in the back disc. So locked it can only be tripped by the longest leg, or only when the minute hand points to XII—in other words, if the minute hand is carried past the III, the VI or the IX spot, the clock will not chime simply because these short trips do not raise the trip lever high enough.

The two locking levers at the extreme right and near the top of the movement extend through the front plate and have on their extended pivots the pawls which ride the locking plates. These pawls are affixed to the arbors by set screws. Assuming that you have set the chime train up correctly and the clock acts as you indicate, your whole trouble lies between these three set screws, one in the locking disc, one in the lock pawl and one in the safety pawl.

There is a pin extending forward in the front locking disc which engages a tail-piece from the strike lock lever and as the chime lock disc turns (R) this pin raises the tail-piece releasing both the strike train and the strike rack very near the end of the fourth quarter chime.

At the completion of the fourth chime operation the pin has just revolved from under the tail-piece and allows it to drop down at about the instant the chime train locks. Its dropping releases the strike train and it immediately starts to strike. There are six arbors in the chime train counting the mainspring arbor as number one, the fan fly being the sixth.

When setting the chime train up the procedure is the same as used for practically all strike trains, the warn run and

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the locking pin being located on the fifth wheel, but aside from this comes the automatic correcting device just mentioned. Part of it is a little disc with only one notch cut in it about midway distant between plates on the fourth arbor. With the chime train set up to the correct locking position, this single notch must be exactly under the little L-shaped locking lever that extends just above it.

Note a small pin in the back locking plate, on its back side and extending from it backwards towards the front plate. This pin is so located in the plate that about the end of the third quarter chime it acts against a short lever pulling the L-shaped lock lever down into the disc with single notch on the fourth arbor.

I hope this will be clear and that you can readily get your chime adjusted—if further pointers are desired, just drop us a line.

J. E. C.

Dear Mr. Coleman:

Sure enjoy your column. I am an amateur clock repairman who has gained much knowledge from your writings—keep up the good work. Now here's my problem. I have a two-spring Sessions Westminster chime clock; it plays the melody correctly and strikes the hour, but I have had trouble getting mainsprings to drive it eight days.

I didn't have the original springs as they were gone when I procured the clock, and I have written to the company but have had no reply. There isn't any model or serial number on the movement or case; it is a rack and pinion affair with the chime roll being charged by the center pinion. I haven't seen but one man who repaired a clock like this one and he couldn't help me. So please give me some help—I'm stuck! It sounds something like the cheater you spoke of in a past issue.

Here is something I might pass on—I own a Seth Thomas one-day wooden case and movement clock which isn't so unusual as to be a collector's item, but of all the wooden movements I've seen, this one differs in one respect. The pinion in the minute or change wheel is free wheeling or mounted in the wheel like the center pinion with a clutch affair—this allows the hour hand to be moved in either direction independent of the minute hand. It appears to be an original idea.

The clock is an Eli Terry patent, is

running every day, is an excellent timekeeper, and the hour hand is mounted with a square hole on a square hour wheel tube. I had trouble with this clock stopping in a cold, damp room, so to correct this I set small bronze bushings on each pivot in the time and strike trains. It hasn't stopped in over a year now and I have tried it in a cold place—probably not the proper repair, but it has proven out.

Another thing of interest; I have several of the Imperial battery clocks, all running. One is a tall regulator and keeps close rate which I converted to run from house current during World War II when batteries were no longer to be had. I rewound the coils and put platinum contact points in place of the brass ones, checked my coils for drain, etc., also put a fuse in so that a surge of current wouldn't damage my coils. It has been running this way for about eight or nine years and is still going.

I will close by saying that I do enjoy all the A. H. & J. and have received knowledge which more than pays for the small subscription charge.

OLIN DENNIS

103 Malone Street
Macon, Missouri

Dear Mr. Dennis:

Your two train Sessions Westminster chime clock is not a "cheater," for it gives you the full four quarters. The German clock I spoke of as a cheater because it cheats its owner out of the fourth quarter chime and only strikes on the hour. E. & J. Swigart Company, 34 West Sixth Street, Cincinnati 2, Ohio, can supply you with the correct spring for this clock.

I differ with you on the wood movement clock not being a collector's item—they are pretty much in demand and not too plentiful. Practically every collector wants at least one example of the wood movement clock—why wouldn't one, if in the original case and in fair condition, be a collector's piece?

The friction hour hand is not entirely new to the wood clock; we've seen a few. Very, very little has been written about the wood movement, somehow they never seem to go into these small details. It is my thought that this feature may have been introduced to enable the owner to coordinate the hour hand and strike easier. Remember these were nearly all one-day clocks and the time side generally outran the strike side; thus, if an owner was away from home or forgot to wind his clock, he had only to pull the little trip wire and bring the strike up to the hour hand's indication.

If the strike got ahead of the hand, he had to strike the clock around to get them together. With this friction on the hour hand, anytime the clock struck six and pointed to five he could move the hour hand to six. Further, I believe that this hour friction appeared only on the earlier clocks where the hour hand fitted on a square. Pretty early in the game they began to fit the hour hand on a round pipe with a sleeve, and this within itself permitted slipping the hand forward (or backward) and thus the friction between the dividing wheel and its pinion was not necessary any longer.

Here is still another thought on the long case wood movements where the hour hand was fitted on a square — the dial train was located between the front plate and dial, and the repairman or assembler had no trouble in marking the square point exactly to the hour mark. With the shelf type movement the dial train went inside the plates, thus without the hour friction special care was required to set the hour wheel so that the square would be right for the hand to point exactly to the hour.

J. E. C.

Dear Mr. Coleman:

I have a customer who owns an old clock with wooden plates. On top of the works is an oval bell quite a lot larger than an ordinary coffee cup, about 3 to 4 inches thick.

We are looking for someone who will make an estimate on this clock for an insurance company—the clock is not for sale. Can you tell me who to write to who can estimate its worth, or what is the proper way to insure a clock of this type?

GEORGE V. PREST

2955 Farnam Street
Omaha, Nebraska

Dear Mr. Prest:

May I point out that you do not mention the case at all—is this a bare movement without a case? A value either for insurance or sale purposes would hinge largely on the case. *Clockwise and Otherwise* never places a valuation on an antique piece for any purpose, this being a specialized line for those who make a business of it. A proper and fair valuation can only be made after a close, first-hand examination of the piece by a qualified appraiser.

As a suggestion, photograph the complete clock, front and side views, then photograph the movement, front and side, and contact some reliable insurance agency with these four photos and the general description of the clock with its measurements. Somewhere in their organization they will have a man familiar with insuring such pieces who will readily advise you the amount of insurance they will allow. The established, reliable insurance agent takes pride in looking after his client's interests.

J. E. C.

Dear Mr. Coleman:

Can you tell me where I can obtain a movement to fit in a china clock with the following measurements: front opening, 3½ inches; back opening, 3⅞ inches; 2¼ inches wide? I would like an eight-day, but would be satisfied with a one-day, but the customer does not want an electric movement.

CLARENCE F. FOSNAUGH
604 First National Bank Building
Springfield, Ohio

Dear Mr. Fosnaugh:

Write James L. Hamilton, Clock Manor, 1901 East Colfax Avenue, Denver 6, Colorado, for estimate and shipping instructions on your china case. They can fit the kind of movement you desire.

J. E. C.

Dear Mr. Coleman:

I am sending you two verges for Ingraham and Waterbury clocks. Will you please secure them for me or tell me where I may secure them.

S. W. BOYD
20 South Seventh Street
Indiana, Pennsylvania

Dear Mr. Boyd:

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neither can we act as your agent and order it for you. Verges of this type haven't been manufactured by the clock companies since World War II and the available supply has long since dried up.

The Young-Neal Company, Chamber of Commerce Building, Nashville 3, Tennessee, are marketing a little kit containing nine pieces for the making of three verges, $1.00 plus postage, if you would like partially prepared material for making your own.

Ralph Herman Clock House, 628 Coney Island Avenue, Brooklyn 18, New York, has on hand some verges at $1.00 each plus postage. These can generally be worked over and fitted to the particular clock being repaired.

J. E. C.

Dear Mr. Coleman:

I was talking to a friend of mine who told me he had seen a Seth Thomas regulator with a sweep second hand and was weight driven. Can you give me more information about this clock or tell me where I could get a picture of it?

HUBERT GOSNELL

15 Julia Street
Asheville, North Carolina

Dear Mr. Gosnell:

When you say regulator, we instantly think of a seconds pendulum (39.2 inches) clock either wall or floor case and can't recall ever having seen a Seth Thomas regulator with center or sweep seconds hand. A check of the few old Seth Thomas catalogs we have does not show a single such listing and several higher grade regulators are pictured and described.

Surely you cannot be referring to an electric clock; I believe all their large dial wall electrics have sweep seconds. During the late war they manufactured two clocks for the Navy with sweep seconds hand. Both were eight-day, spring driven, bulkhead mounting type—one with six inch dial and one with 8½ inch dial. Can you check with your friend for some more definite information and write us again?

There is that possibility that he saw an "altered" clock—we know of one such clock; it was originally the regular Seth Thomas seconds pendulum regulator whose owner had lowered the movement so that the second pivot was in the center of the glass opening. He had geared the center post a couple of inches below its original spot and utilized a small hour and minute dial between the center and VI on the order of an astronomical type dial.

J. E. C.

Dear Mr. Coleman:

I have a desk clock in for repairs and it needs a hairspring. The only name on the clock is "Helveco" made by the Helveco Clock Company, Switzerland. I would appreciate it if you would tell me as to where I can get a hairspring vibrated for this clock, better yet, where can I obtain a balance complete.

It sure seems like the Swiss manufacturers export a lot of desk clocks, but fail to follow up their exports with a supply of spare parts. At least that's the story that all the clock supply houses tell me.

PETER SICHAK

10210 Ewing Avenue
Chicago 17, Illinois

Dear Mr. Sichak:

We do not locate the Helveco listed under that trade mark name, but believe that Watches of Switzerland, 597 Fifth Avenue, New York 17, New York, are the distributors for it.

Hairspring Vibrating Company, 406 Thirty-Second Street, Union City, New Jersey, will render you accurate, one-day service on hairsprings.

J. E. C.

Dear Mr. Coleman:

Your name has recently been referred to me as a source of possible help with a problem. Some time ago I fell heir to a very old Seth Thomas clock which needed considerable work done on it to restore it, but since the clock had formerly belonged to a very dear old friend, I felt my expense was worthwhile to restore the clock to good working order.

A furniture re-finisher was working on the cabinet when a tool slipped and he broke the glass door, that is, cracked the glass straight across in two places. The glass door happened to be the most beautiful and charming thing about the clock, and the most rare.

The design is done in gold paint, delicate tracings of design and flowers with an edging like ribbon. There are two round bare places, for the face of the clock to show through, and for the pendulum.

The man who broke the glass has been searching all over Los Angeles trying to replace the door. I search also — every antique shop, every painter, trying to find some means of replacing the door. I regret very much that the man doing the work was apparently careless. Can you offer any suggestions?

MRS. GERTRUDE PRESSEY
6007 West 75th Street
Los Angeles 45, California

Dear Mrs. Pressey:

Send the broken pieces of your glass, carefully packed, to Edwin B. Burt, 21 Loring Road, Auburndale 66, Massachusetts, and ask him to write you the estimate to duplicate it. He has been doing this type of restoration for years and he is in a position to make you a glass you can't distinguish from the original.

J. E. C.

Always remember, a jeweler can take a day off—but he can't put it back.

* * *

A smart jeweler is never too busy to attend church regularly. After all, even a jeweler can't live on bread alone.

* * *

Jewelers who keep pulling strings usually have a hard time making ends meet.

* * *

Every jeweler should be married, especially in the winter time when a wife comes in handy shoveling off the front walk.

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THE WATCH REPAIRMAN AND THE OSCILLOSCOPE

By Carl H. Anderson

UP TO NOW we have given you our charts on *"Adjusting," "14-Position Adjusting,"* and *"Dynamic Poising."* Herewith we are publishing our chart on *"Centering a Hairspring in a Watch Without Removing the Balance Assembly."* This chart (p. 54) is practically self-explanatory and we do not feel it necessary to say too much about it. This chart is to be used where the shape of the overcoil is correct, but when the balance is put into the watch it is observed that the hairspring isn't quite centered. It is not to be used for reshaping the overcoil, as that is assumed to be correct or at least nearly so.

By carefully observing the chart you will notice we have drawn the overcoil shape as used by Elgin. The principles of the bends for centering are the same for the hairsprings used by Waltham, Hamilton, Gruen, Longines, Bulova, etc. The bend at "A" is made after the overcoil has completed its raise and is leveled off, and the bend at "B" is made just beyond the end of the regulator arc.

In the Elgin type hairspring the bends at "A" and "B" are made entirely in the arcs and nowhere else. For example let us say the coils are found to be wide apart in the body of the hairspring at 1, therefore the coils would be close together at 2. If you will close the arc "A" very slightly you will shift the body of the hairspring toward 2, thus closing the coils at 1 and opening them at 2. On the other hand, if the coils are wide at 2 and close at 1, you would open the arc "A".

If it is a pocket watch, this is very easily done with the Dumont "H" tweezers, which are commonly known as Elgin-type hairspring tweezers. Dumont makes a series of hairspring tweezers where the points are concave on one tip and convex on the other. By placing these tweezers exactly on the arc, either one way or the other, it is very easy to close or open the arc. If your coils are open at 3 and therefore closed at 4 you need to shift the body of the hairspring toward 4. This is done by closing the arc at "B". The opposite is done if the coils are wide at 4 and open at 3, you open the arc "B".

In small wrist watches, you can use a pair of either 3 or 3C Dumont tweezers and standing a needle vertical against the hairspring to hold it while bending with the tweezer. After a few trials you will find this method to be very simple and effective. You will soon learn to become quite proficient at it. On flat hairsprings the operation is similar. You first locate the wide and narrow points of the coils. Then go 90° (¼ turn) from either the wide or narrow point and bend the spring either in or out at that point. Of course the bend is made on the outside coil and not elsewhere.

Next month we will publish our chart on *"Leveling a Hairspring in a Watch Without Removing the Balance Assembly."* You will find this chart to be equally as simple as the one published this month. These charts will be followed by some very interesting charts which we now have on our drawing board.

Remember any of these charts are available as photographic enlargements on single weight high-gloss paper suitable for framing or cementing to a heavy piece of cardboard. If you use the charts as printed in the magazine you will soon find your magazine is becoming dog-eared, worn and torn. On the other hand mounting the charts on a heavy piece of cardboard using

Mr. Anderson will be glad to answer any question pertaining to the Oscilloscope. Queries should be sent to him in care of the American Horologist & Jeweler, with a stamped return envelope enclosed.

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Try our fast service on your next job.

HAIRSPRING VIBRATING: Flat—$2.00 Breguet—$3.00. Our service is not cheap—just fast and accurate. Send only the balance complete, stud, collet, and balance bridge. ★

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WATCH MATERIAL and TOOL SUPPLIER: We would like very much to be your supplier. We will gladly send you our latest catalogs and a free combination Movement and Springbar Gauge on request with your order for any item on this page. ★

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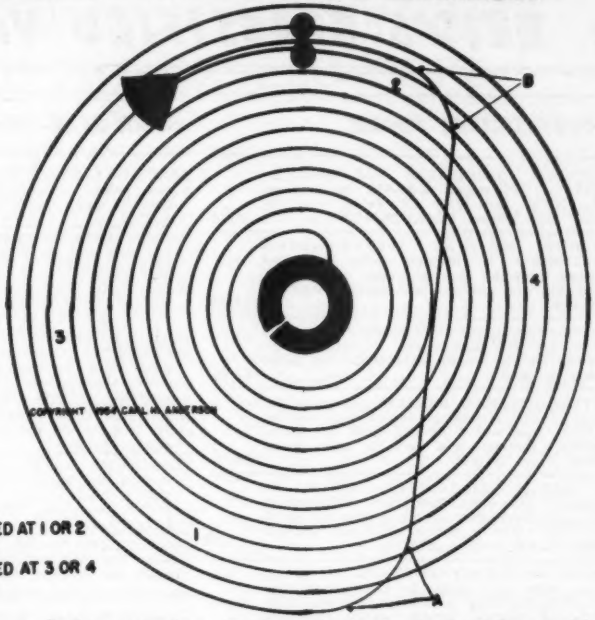
CENTERING A HAIRSPRING IN A WATCH WITHOUT REMOVING BALANCE ASSEMBLY—



COILS OPEN OR CLOSED AT 1 OR 2
BEND AT A
COILS OPEN OR CLOSED AT 3 OR 4
BEND AT B

paper rubber cement, and then spraying the surface with lacquer will make the charts last for years and years. The ones we use on our bench every day have been in use for over 8 years and are still in good condition. All of the charts may be purchased in 5″x7″ size for $1.00 each or in 8″x10″ size for $1.50 each.

* * *

We have received a very large number of letters from readers who have bought and are using the oscilloscope in their everyday watch repair work. All of them state they are doing better work in much less time than ever before. All are quite enthusiastic about their use of the oscilloscope. They also state they are finding many mechanical faults with the oscilloscope they were never able to find before. Everyone of them say they would not be without it. If you aren't yet using the oscilloscope at your bench you really do not know what you are missing.

* * *

We are very proud to be able to tell you that our articles are now appearing in the "Journal" of the British Horological Institute, beginning in the July, 1954 issue. They are starting with the same articles which began appearing in A. H. & J., back in April, 1953. With the foreign circulation of A. H. & J., and that of the Journal, our articles will be read in every country on the face of the earth where there are watch repairmen. Since the British Horological Institute has approved our articles for publication, it should further prove to you that the oscilloscope is an indispensable instrument in modern watch repairing.

* * *

During the latter part of July we took a trip down through Southern Indiana and Central Kentucky, picking up quite a few new subscribers for A. H. & J. One of the interesting things we ran into was a good watchmaker who had never heard of the resuming and recovery rates of a watch. Since he had attended a special school on adjusting and timing watches with a timing machine, he asked why they had not mentioned these two rates and by his talk rather indicated he doubted the existence of such rates.

We asked him if the store sold any

Swiss watches which were accompanied by Bureaux Bulletins. He walked over to the other side of the store and picked out a few watches which were accompanied from Switzerland by these bulletins. We pointed out and explained to him the various rates and showed him the resuming rates of the particular watches which were laying on the show case. We did a little explaining, then showed him the National Bureau of Standards Circular C432, entitled "Testing of Timepieces" which includes the recovery rates. After examining the Bureaux Bulletins and the National Bureau of Standards circular he readily agreed of his own free will there were such rates. He further stated these rates must be important or they would not be included in the official government tests as used in England, France, Switzerland and the United States. We gave him a little further explanation of the resuming and recovery rates and when we were ready to go he said he now realized these two rates were the ones which actually determined how the watch kept time for the customer instead of the position, isochronous and temperature rates as he had been taught.

When you read about these rates in previous issues, did you overlook their importance? Or didn't you realize these are the two rates which you really must correct to have the watch keep the right kind of time? Please do not misunderstand us, we are not trying to upset all you believe or have been taught, but it is as Mr. Henry Fried said of us: "The question of otherwise staid horological ideas." We are merely trying to put you straight on a lot of things and don't you think for one minute that A. H. & J. doesn't have plenty of readers who would correct us if they could prove us wrong.

We will now ask you a serious question: Is there any other Horological Magazine or jewelry trade journal anywhere in the world which gives you every month, month after month, the real, down-to-earth, useable watch repair information that *The American Horologist and Jeweler* does? Don't you honestly believe you should tell your fellow watch repairmen what they are missing by not reading A. H. & J. from cover to cover each and every month?

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THE OSCILLOSCOPE—Continued

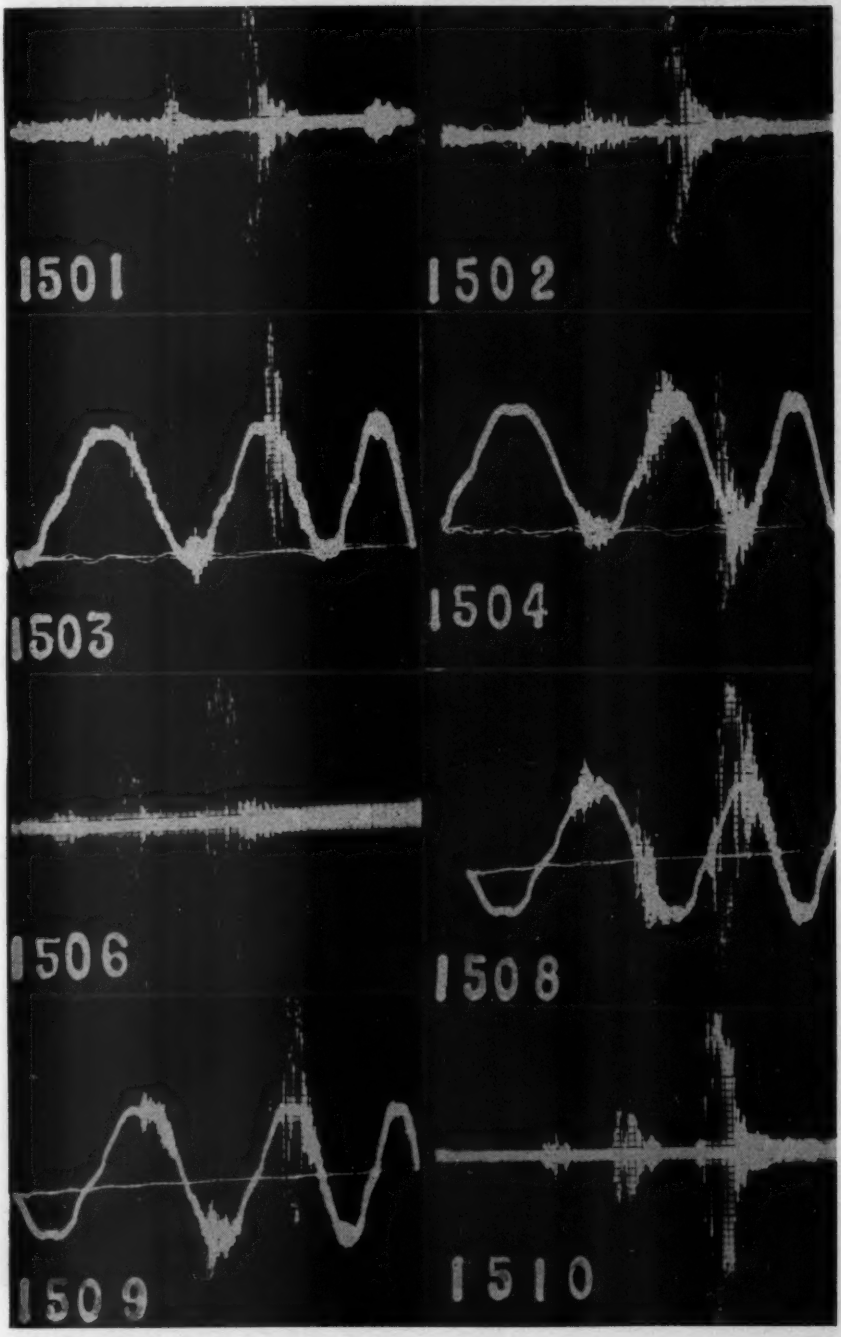
FOR the first watch to be used in our cleaning and oiling tests we selected an old 12 size, 21-jewel model. Our reason for this is that it is a watch of what we consider commercial grade and definitely not of railroad grade standards. However, it is a good watch, shows practically no signs of wear whatsoever and is in fairly good mechanical condition. We present herewith a series of oscillograms made of this watch about a year ago. We bought the watch second-hand from another watchmaker and understand it had been more than five years since it was last cleaned. We have never had the watch completely apart so will have to report on its exact condition when we dismantle it. Our oscillograms show it to be an excellent example of bad oil condition. The positions and sweep rates of the oscillograms are as follows:

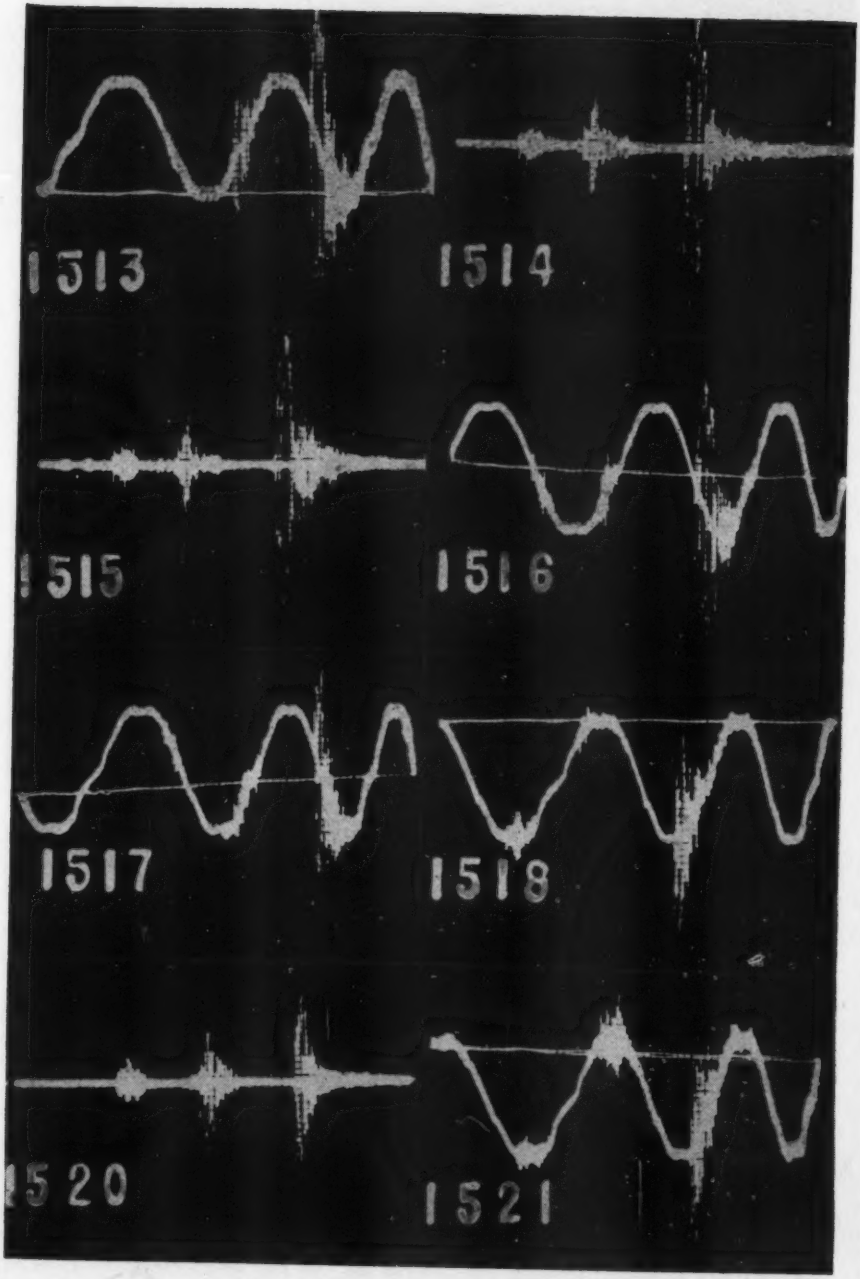
Number	Position	Sweep Rate	Number	Position	Sweep Rate
1501	PU	20	1518	PL	20
1502	PU	20	1520	PL	20
1503	PU	20	1521	PL	20
1504	PU	20	1523	PD	20
1506	DU	20	1524	PD	20
1508	DU	20	1525	PD	20
1509	PU	20	1527	PU	30
1510	DD	20	1528	PU	30
1513	PR	20	1529	PU	30
1514	PR	20	1530	PU	30
1515	PR	20	1535	PU	30
1516	PR	20	1536	PU	30
1517	PR	20			

We will not attempt to go into a detailed explanation of each one of these oscillograms but will reserve this for a later article. We will mention only a few of the outstanding points.

No. 1501 and No. 1502 show considerable difference between the receiving and discharging pallets. In No. 1501 there is a considerably greater force of impact when the locking corner of the escape wheel tooth strikes the impulse face of the pallet stone. There is less pivot slap than in No. 1502. The lever settles much more quickly after safety lock in No. 1501 than it does in No. 1502. All the pivots move over in their holes (pivot slap), after total lock, much more quickly in No. 1501 than they do in No. 1502. The total escapement action time in both of them is very close to being the same. The roller jewel striking the fork slot at entry is of slightly greater magnitude in No. 1502 than it is in No. 1501. The scraping of the impulse face of the escape wheel tooth across the impulse face of the pallet stone is of slightly greater magnitude throughout the entire length of the pallet stone in No. 1502 than it is in No. 1501. In No. 1501 the impulse force dies off very quickly after the locking corner of the escape wheel tooth strikes the impulse face of the pallet stone. The impulse force in No. 1502 is of greater duration of time but less in initial force.

In No. 1503 we find the time duration of the escapement action to be about the


1501
1502
1503
1504
1506
1508
1509
1510


1513
1514
1515
1516
1517
1518
1520
1521

same, but the impulse in No. 1504 is far greater and better. In No. 1503 the lever settles very quickly at total lock after the let-off of impulse. There is practically no rebound. In No. 1504 there is good rebound of the lever due to the greater impulse force. After let-off of impulse the lever strikes the banking pin, bounces back to safety lock very quickly. The locking corner of the escape wheel tooth strikes the locking face of the pallet stone with fair force and rather sluggishly draws the lever back to the banking pin, which causes a rather slow draw to total lock. After total lock the pivots rather leisurely move over in their holes.

In No. 1506, the dial up position, we find the roller jewel striking the fork slot at entry with fair force, but no rebound of the lever away from the roller jewel. The roller jewel pushes the lever over until unlocking occurs allowing the locking corner of the escape wheel tooth to strike the impulse face of the pallet stone with fair force. The impulse immediately dies out with practically no pivot slap. At the let-off after impulse the lever is quite uncertain in what it intends to do. It moves over to the banking pin, starts to rebound but doesn't do so quite quick enough as the escape wheel tooth moves forward to strike the pallet stone about half-way between safety lock and drop lock. Draw takes place and the lever assumes a position of rest almost immediately thereafter with only a very, very slight movement of the pivots in their holes of the balance staff, pallet arbor and escape wheel pinion. The total escapement action time is about the same as in the previous oscillograms.

In No. 1508 we find very little difference from No. 1506 and the total escapement action time to be about 18 milliseconds. A slightly rough jewel hole does show up in this one. Notice the jagged anticline after total lock, stopping at the bottom of the valley. In No. 1509 the impulse isn't quite as good and the locking time is much worse than in No. 1508.

In No. 1510, the dial down position, we find a totally different condition. All forces are of fair amplitude, indicating the upper jewels are in better condition than the lower ones.

In the pendant right position, Nos. 1513, 1514, 1515, 1516 and 1517, we see very

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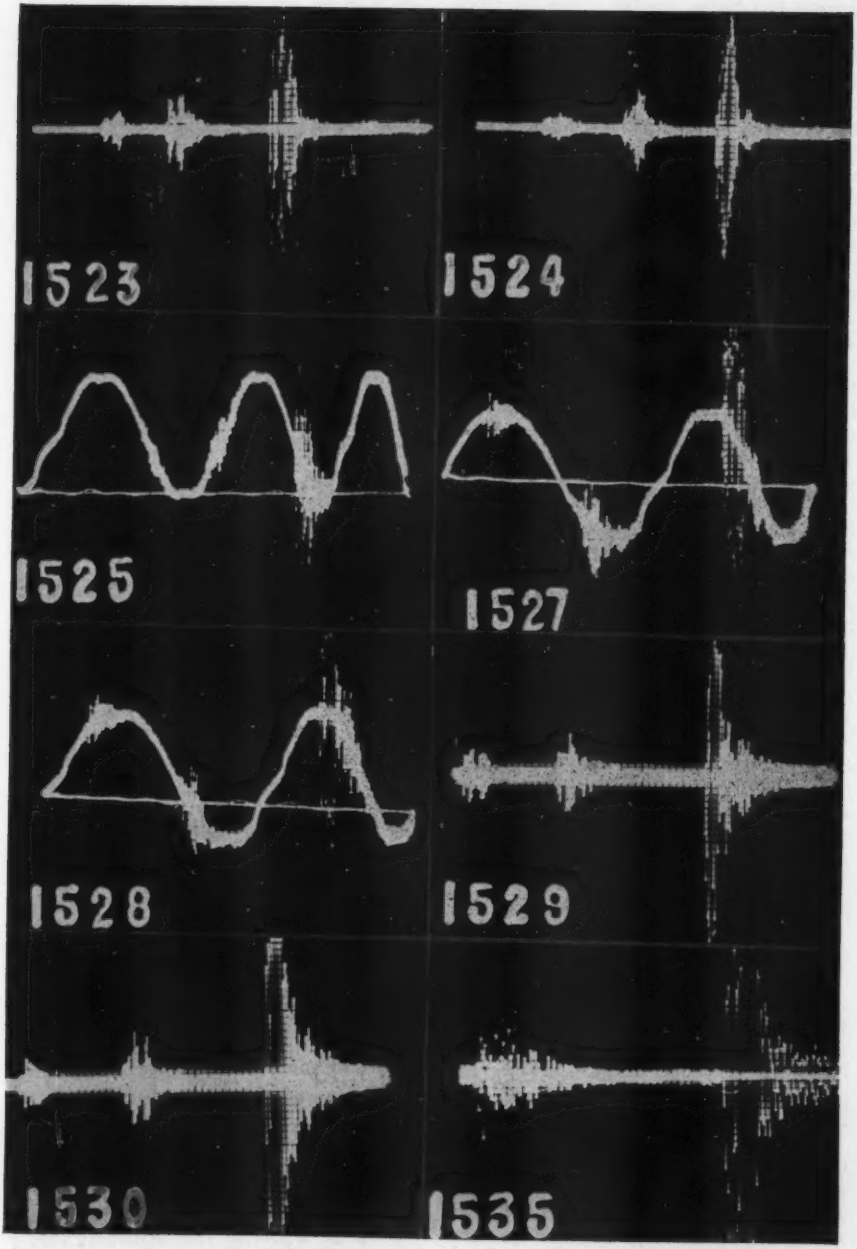

1523
1524
1525
1527
1528
1529
1530
1535

clearly the effect of gravity on the lever and the consequent result in the unlocking, impulse and locking. This effect is also clearly seen in the pendant left position, Nos. 1518, 1520 and 1521. Compare Nos. 1514 and 1520 and you will readily see the difference, No. 1514 being much the better.

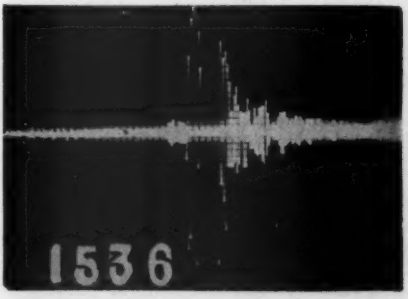
In the pendant down position, Nos. 1523, 1524 and 1525, you will notice this position to be much better than that of pendant up. The total escapement action time, however, is somewhat faster, being about 21 milliseconds. In Nos. 1527 and 1528, sweep rate 30, you will notice the total escapement action time is slightly more than 24 milliseconds.

In Nos. 1529, 1530 and 1535, we clearly see the difference in the action of three of the escape wheel teeth, showing the oil has not congealed to the same extent on each of the impulse faces.

• • •

Look at No. 1536. What do you think it is? Give up? It is only the locking action. The sweep was expanded until only the locking action appeared on the raster. Here you can see all that is taking place from the time of let-off of impulse until the escapement is fully locked and the pivots have moved over in their pivot holes. See if you can pick out each one of the various actions. We will reserve a complete analysis until you have had the opportunity to study this one.

As we have said before, we could make quite an extended study of these oscillograms, but this will suffice for the present. Later on, when we get into a more detailed study of escapement action, we will refer back to these and other oscillograms to point out various things which are omitted at this time.



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Jewelry Repairing

By R. ALLEN HARDY

SETTING A STONE IN A FLAT-TOP OR BLOCK SETTING

Setting a stone in a flat-top mounting is the most challenging and interesting of all the setting jobs (in this writer's opinion) not because the results are more beautiful or attractive, but because the job requires more skill and technique.

A diamond perfectly set in a flat-top mounting is truly a thing of beauty for the stone is flattered and magnified by the brilliant surfaces surrounding the stone. Small stones look larger and large stones more radiant.

This style of mounting seems to be as much in vogue as it ever was. The shape of the mounting may vary in design, but the setting style usually remains the same. The approach to setting the stone is exactly the same as explained in the July and August issues dealing with setting Tiffany and fishtail settings.

The difference is in the new treatment of securing the stone and "finishing up" the job. Instead of bending claws or prongs, "beads" are carved out of metal and maneuvered over the girdle by means of special gravers and beading tools. Surplus metal is trimmed away in a very exacting manner and finishing touches are given to the job with a milgrain tool. This is a very general explanation of what really occurs.

Let's start from the beginning and follow the setting procedure step by step. The first thing to consider are the proper tools with which to execute such a specialized operation. The following list is adequate for a beginner:

One #42 flat graver
One #52 round graver
One #1 knife-edge graver
One milgrain tool
One set of beading tools

This list is, of course, in addition to the equipment already acquired for setting Tiffanys and fishtails.

The No. 42 flat graver is rather wide and one may well wonder why use such a wide tool for this job. The reason is logical. The No. 42 graver will accomodate any size setting, large and small, and while it is a good thing to have No. 38 and No. 40 handy, the only absolutely necessary graver is No. 42.

The No. 52 round graver is used to "work-up" a bead at each corner. This will be discussed in detail later. The beading tool is used to press the bead (carved out with the round graver) firmly against the stone. It serves two purposes—not only does it shape the bead into a perfectly formed ball, but it polishes the surface as well.

The milgrain tool is the last tool used. This tool forms the series of minute beads framing the setting job. This row of beads may be a single or double line, or row, depending on the amount of metal left after the stone is set. I have seen as many as 4 or 5 rows of milgraining used on a flat-top mounting that held a very small diamond. This is not generally a good practice to follow, inasmuch as this treatment tends to emphasize the smallness of the diamond. It is far better to select a flat-top mounting with an area more nearly matching the size of the stone to be set. Of course a customer may choose a large mounting for a small stone, in which case there is nothing to do but use as many rows of milgraining as are necessary.

The knife-edge graver is used to cut furrows or lines preparatory to using the milgrain tool, if more than one row of milgraining is used. Before going into the details of setting the stone, first consider what alterations should be made to the

Mr. Hardy invites your questions pertaining to jewelry repairing. Questions should be directed to Mr. Hardy, c/o The American Horologist & Jeweler, Box 7127, Capitol Hill Station, Denver 6, Colorado. Please enclose a self-addressed, stamped envelope.

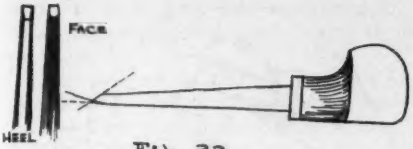

Fig. 32

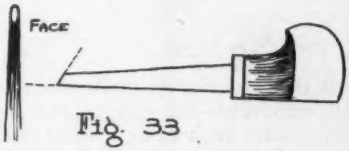

Fig. 33

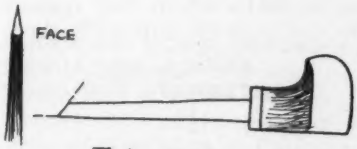

Fig. 34

flat graver, the round graver, and the knife-edge graver.

Shape the No. 42 flat graver as shown in figure 32. Be especially careful to bring the heel of the graver to a brilliant polish, remembering that a graver only cuts as bright as it is polished. Shape the No. 52 round graver as illustrated in figure 33. The belly of the graver is not touched on the India or Arkansas stone. It may be touched lightly to medium fine emery to remove burrs left from sharpening the face of the graver.

The knife-edge graver must be very carefully prepared. Grind a face as shown in figure 34. The two sides of the graver may be rubbed on the Arkansas stone much in the same manner in which one would sharpen or edge a knife blade—this is done near the tip where the cutting occurs. Be very careful not to get a "feather edge" or one too thin as the first attempted cut will damage the tip and it will have to be re-sharpened.

Now to begin the setting job. Measure

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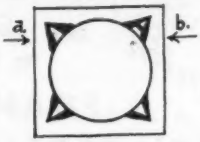

Fig. 35

the stone and sink the burr as previously discussed under Tiffany and fishtail settings. When the stone is at a depth where an adequate bead may be raised (this is shop talk—it means where a sufficient amount of metal may be pushed over the girdle of the stone—enough to hold it secure), with a square graver or knife-

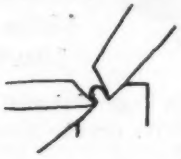

Fig. 36

edge graver, cut out an island of metal (which will be developed into a bead)—see figure 35. Do this in all four corners.

With a No. 52 graver work up a bead as shown in figure 35B; this is done very simply by placing the edge of the graver halfway between the beginning of the cut

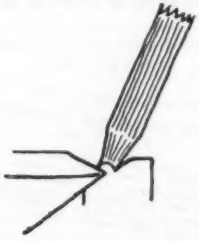

Fig. 37

and the edge of the stone. By wiggling the graver back and forth, the graver's edge will bury itself in the metal, and as it reaches a depth as shown in figure 36, gradually lift the graver upward—this will

Fig. 38

push the bead over the girdle of the stone. But, remember—the duty of this tool is only to start the bead to bending over the girdle of the stone—it cannot and should not be used to tighten the stone.

Tightening the stone is done by using the beading tool, see figure 37. This will bring the bead absolutely flush against the stone, and to do this successfully, the tool

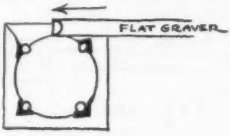

Fig. 39

should be used as shown in figure 38 and rotated in a circluar manner. This does the job of both polishing and pressing the bead firmly against the stone.

The remaining operations have to do with merely removing excess metal and beautifying the setting job. With the No. 42 flat graver trim away the surplus as

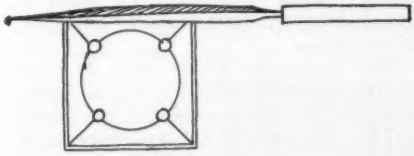

Fig. 40

shown in figure 39; be sure to "square up" the corners accurately—see figure 40. When all sides and edges are smooth and true, use a No. 4 file to edge the job—see figure 40. This will result in a perfect

track for the milgrain tool—see figure 41. After milgraining, the job is complete—see figure 42.

Depending on the size of the stone as related to the size of the mounting, more than one row of milgraining may be used. The only remaining operation is to very lightly touch the job to a bristle brush (not too stiff or too firm), and do not over-polish, for the beading formed with the milgrain tool may be spoiled.

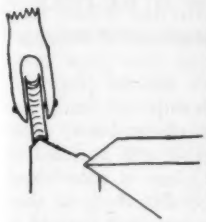

Fig 41

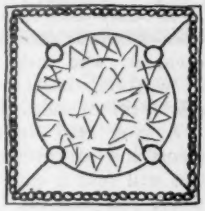

Fig. 42

CALIFORNIA HOROLOGICAL ASSOCIATION ASPIRES TO HIGHEST STANDARDS

Norman D. Luth, secretary of the Horological Association of California, is urging all California watchmakers who do not hold proficiency examination certificates to apply for such examinations of their choice. Those successfully completing the examinations, State Board, U.H.A.A., or H.I.A., will be awarded a Watch Key with jewel and inscription, and will be eligible for a $1,000 surety bond attesting to the watchmakers' honesty.

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PUBLIC RELATIONS FOR HOROLOGISTS

By Robley D. Stevens, LL.B., J.D., LL.D.
Public Relations Counsellor

What does the public think of time repairing experts? Here's a survey which you may want to use.

MOST people are not aware of the vast amount of skill, specialized training and wide experience which competent horologists must have to succeed in these competitive times. Many people think some of them are professional gyps. Unfortunately, all horologists do not support their professional association, and that is where they are wrong.

In the past few years there has been a widespread interest in public relations activities which are carried on by American industry. In fact, "brand-names" watch firms spend sizable sums to sell their timekeeping products to the public.

This study was undertaken because it was felt by the writer that all horologists are entitled to have excellent public relations. It is based upon personal contacts by the writer with a dozen or more horologists throughout the country during my travels. It also includes a quiz from a number of people who regularly patronized horologists for all manner of purpose. Thus, this first-hand information can lead you into many interesting and profitable things, because the possibilities of good, sound public relations for horologists is as necessary as the art and science of timepiece repairing.

The principal objective of this survey was to ascertain what the public thinks of the craftsman in watch repairing work. It is intended only to aid the horologist who desires to establish and maintain better public relations; for the subscribers of *The American Horologist & Jeweler* magazine.

As you all know, timekeeping work is one of the oldest sciences known to man. The ability to exercise skill in repairing watches, clocks, etc., requires much of the horologist. **This is certainly an important** profession today, particularly since civilization depends upon accurate and adequate timekeeping products.

Since the objective of this presentation is to study and appraise the public relations activities and programs of those individuals who make up this great body of workers, there is a definite place for this form of salesmanship for you.

As you read these observations, comments and suggestions, it will be ideal if you will find a quiet place in your home where you will not be disturbed, so that you may concentrate upon what type of a public relations program you can adopt to safeguard your hard-earned reputation, and also to increase your earning capacity.

I am deeply grateful to Mr. Edd Ashmore, of Washington, D. C., who is a horologist, for his help and guidance in regard to the research issues involved, and now realize after consultation with him that there should be a special appreciation for the public relations for horologists everywhere.

The purpose of a good, sound and perpetual public relations program has a twofold purpose: (1) It assists the horologist in planning his work and aids him in developing methods for increasing his efficiency; and (2) it gives him an opportunity to understand what the public thinks of him as an individual, and also as a competent worker. Through the interpretation of such a public relations program you, too, can plan, work and increase your earning capacity if you build a fine reputation.

The facts uncovered by this survey should be of vital concern to every horologist. Unsound and bad public relations are a detriment both to your hard-earned reputation and earning capacity, regardless of how skillful and experienced you may be. Most timekeeping specialists would agree that such relations are more imperative than ever before, particularly in view of the fact that with a new administration in control of our national government,

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there will be less red tape, less governmental intervention and more encouragement placed upon free enterprise, in the competitive era that lies ahead for all Americans.

In order to obtain a practical viewpoint of this public relations business, perhaps the simplest thing to keep in mind is that you depend upon the public for a living. In addition, you should realize the significance of the fact that America's biggest, greatest and most successful companies spend millions of dollars annually on sound public relations programs. This in itself is conclusive evidence that it pays off in the long run.

You, as well as every other timekeeping specialist, are vitally interested in your financial success. Success in this great industry depends upon public relations, just as it does upon watch repairing skill and experience. If you have good public relations, you will prosper.

From here on, you are going to profit from public opinion gathered by this survey. You will do very well if you utilize this material from time to time, when things go wrong in your watch repairing business.

• • •

There is no doubt that the personal qualities of a horologist are important. The public likes to deal with a person who is pleasant and willing to serve. The public *will* go out of its way to give you watch repairing business if you will deliver the goods for a fair price, make a reasonable profit, and consider the customer. This theory has been tested in all walks of free enterprise and it pays off beyond words.

In order that you may gain a better insight of your customers, you should become friendly with them on a business-like basis. Everyone likes to do business in this manner. You will find it to your advantage if you will use salesmanship in your relationships with the public. It helps you to build goodwill.

You do not need a large amount of capital to carry on good public relations. You can build goodwill through your own individual efforts. However, sometimes, it may pay you to hire outside, impartial counsel to conduct a public relations program which can help develop a closer feeling of harmony and goodwill among your customers—the public.

The various aspects of public relations for horologists cannot and should not be overlooked. It is primarily based upon trust and confidence. Before the public can be thoroughly convinced that you are the watch repairer to do its work, it must be convinced that you will provide benefits and economy in general.

The economy of the United States has always been and must always be a competitive economy. The better worker is entitled to the fruits of his labor. Anything less could result in socialism. To maintain free enterprise in this great industry of timekeeping production or repairing, there must be education and enlightenment of the public. That is, a better understanding between the public and businessmen in this field.

Obviously, you must give much more than lip service if you are to profit from public relations. You should do everything you can personally, and through collective effort, to explain and interpret the nature of your work.

You have now come to what I call a critical part of this article—public relations for horologists. From here on, you are going to get the views of the writer

from personal contact with timekeeping experts, including the reactions of various respondents. In a few words, you will learn what kind of a person the horologist is as far as the general public is concerned, subject of course to exceptions.

In visiting several horologists in connection with work to be done, I discovered that there seems to be a widespread resentment by the public of prices charged for certain watch repairing jobs. However, this interview found resentment for the most part on the general public's ignorance of the various elements which go to make up the horologist's prices.

One respondent told me that he had no idea of how the charges were made. Two or three other respondents stated that while they knew, charges covered several price categories. Several more respondents claimed that charges were too high, especially with regard to cleaning a watch, putting in a new mainspring, and purchasing a balance staff.

The survey also pointed out that too many watch repairers just do not know their job sufficiently to justify the charges they make.

You know as well as I do that the public's ignorance of the horologist's background and costs of doing business these days with rising costs and labor is one that must be analyzed. Naturally, the public cannot be blamed for its ignorance, primarily because horologists have not told the public the facts. The public does not know what you have to pay for parts and supplies to perform your work.

The survey further revealed that too many people in this business are too inconsiderate of the buyer. The respondents claim that some watch repairers are out to take what the traffic will bear and that others just don't render satisfactory service.

Last, but not least, the survey disclosed that the respondents stated that those in this business dealing face-to-face with customers lack the personal qualities required in any public relations business. A few stated that many are not interested in the buyer's welfare; that is, they render poor service and disappoint the customer in fulfilling the promises of a contractual agreement.

In addition, some other respondents claim that they do not have confidence in certain watch repairers; others say that they will only go to a reputable one upon recommendation of previous customers who are satisfied. Further, a few respondents claim that they can get their watches or clocks repaired just as good (or almost as good) at cut prices based upon advertising claims of the horologist. And one respondent went so far as to say that, after having work done, one watch repairer is a "twister." Twisting, according to definition, is misrepresenting facts in order to get the business.

• • •

Public relations for horologists enters into other fields of business relations, too. For example, you will find it worthwhile to advertise consistently and regularly, whether by newspaper or by direct mail. set up good displays furnished by the "brand names" companies. You will also find it worthwhile to employ an outside In addition, you will find it profitable to agent to solicit watch repairing work on a house-to-house basis. You can probably keep this business from going to the department store or other sources, thereby controlling the work within the confines of your own individual workshop. Obviously, your association can help in several ways to improve the quality and quantity of your watch repairing business.

You understand, of course, that the ignorance of the horologist's background as far as the public is concerned would be humorous if it weren't for the fact that it can be a dangerous and costly thing. In fact, it could force you out of business overnight.

You know as well as I do that horologists who are competent must have a minimum amount of education and training to do this work.

One respondent said to me: "I think the average watch repairer is just one step above the laborer." I was amazed at such public reaction.

You must realize and understand, for most of those in this industry, public relations calls for a great deal of conscious effort. In other words, it is an industry-wide concern. Horologists everywhere should be quite willing to spend some time and money through advertising and public

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relations to the true facts regarding their background, work performed, skill required, business expenses, etc.

This analysis attempts to go down deep to the grass-roots level to point out how everyone in this industry can do his part to develop better public relations and thus increase his business. Horologists must advertise collectively; they should attempt to justify prices by telling the public what it is entitled to know, and they should conduct their individual business on a friendly basis so as to sell the public why it should have timepieces repaired periodically and checked regularly. Please try to understand that the suggestions and counsel presented here is not wholly imaginary, because the public is conscious of the horologist and his job.

In conclusion, certain facts have been gained through this survey. Undoubtedly, you can realize how sound public relations can be a phenomenally rapid-rising thing in your favor if you will develop it. It is a kind of thing that picks up speed when it is cultivated.

Yesterday, you repaired a customer's watch. When tomorrow comes, you wonder if he will come back to you. You hope he will and hope, also, that he will send you more customers because you tried to give him the best type of work you are capable of doing. It seems to me as a public relations counselor, that such a relationship between the horologist and the public ought to be a cooperative and complementary thing.

If you will merely apply your personal qualities, supported by your experience and technical knowledge in the general field of timepiece repairing work, you will set out to develop your public relations. You can increase your business if you will get to know your customers and treat them as you would like to be treated.

Sure, you are under pressure of work and probably feel you can't develop a better public relations program. Consequently, you are satisfied with whatever work that comes in. Successful free enterprise requires hard work. Yet, you'd be surprised to learn that if you don't have good, sound public relations, your competitor will. As a result, he will get your business.

• • •

A good public relations program will counteract anti-business propaganda spread by any source. But you, and you alone, must take the initiative to prevent any damaging or motivating force which tends to discredit the reputation of the honest, hard-working horologist.

With this approach, there is every opportunity for the development of a good, sound public relations program for every horologist in America. It can be a mouth-to-mouth project with special emphasis on serving the public. It can also involve a better communication system with the public—your coveted customers. Unfortunately, good deeds do not always speak for themselves, and neither does good work. The public must be constantly sold on your work and service. As one authority put it: "If a man makes a better mousetrap than his neighbor, though he build his house in the woods, the world will make a beaten path to his door." Whether you want to take advantage of this philosophy depends, of course, upon how you want public relations to affect you. The public must be constantly told of the good work of every horologist. This is necessary because we all are living in a dynamic,

changing world, with many conflicting forces at work, either to destroy our good deeds or through greed which may cause irreparable damage to everyone.

Throughout this presentation, you were told the value of a public relations program. There is ample evidence to be found in our free enterprise system that it pays off. However, it requires joint effort, sincerity, truth, honesty and consistency to be effective. If handled properly and adequately, there will be good, sound public relations for horologists. What do you think?

A One-Minute Business Sermon

By DAN VALENTINE

The smart jeweler keeps an ad file.

Advertising is one of the most important factors in the success or the failure of a retail jeweler.

In fact with present day competition in the jewelry field advertising is sometimes the difference between red ink and black ink.

And that's why successful jewelers keep a file of good ads.

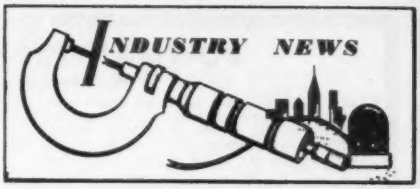
And I don't mean their own ads either—although it's a must for jewelers to keep a file of their own newspaper advertisements along with a performance record of their effectiveness.

What I am getting at is that an ad file of advertisements of firms will pay off.

If you see an ad of a grocery store that stops your eye, pause and study why the advertisement attracted your attention in the first place. Clip the ad out and it can give you an idea for a good jewelry ad some day.

It's just good business too to buy out-of-town papers once in a while. Go down to a hotel news stand and pick up a batch of papers from towns in various parts of the country — Boston, Dallas, Spokane, Toledo, Nashville, New Orleans, San Francisco.

Go through the papers page by page and notice the jewelry ads. You'll get a different — and entirely new slant on the business.



U. S. WATCH DIAL REFINISHES DIAL OF HISTORIC CLOCK

An historical narrative was unfolded recently when U. S. Watch Dial Company refinished the largest clock dial ever handled by this firm.

The removal of the 44-year-old outdoor clock, which cost only $37.50 when it was bought in 1910, caused such an uproar in Richmond, Va., that the owners of the building to which the clock was originally attached were obliged to put it back on display.

The clock, which was installed and built into the woodwork over the main door of the old Churchill bank, was removed from service in October, 1951, when the building was renovated. A large tobacco leaf was placed over the hole where the clock had been on exhibit.

In the interim, the bank was taken over by the State-Planters Bank and was renamed Churchill Branch.

But the public wanted the clock, and the clamor grew until the new owners of the bank decided to refinish the dial of the clock. The bank called in Carl's Jewelers of Richmond, which in turn sent the dial to U. S. Watch Dial Company in New York City.

In refinishing the dial, U. S. Watch Dial Company encountered difficulties, in that the background lacquer of the clock was worn off, and the name of the old bank, which was on the clock, had to be replaced with the name of the new bank.

Mrs. Anne G. Singer, in charge of the clock refinishing department, and her husband, Eddy Singer, general manager of U. S. Watch Dial, reported that the dial has a 24" diameter, as contrasted with a common traveling clock dial, and dial with a six inch diameter in the photo (p. 70).

The clock is one of the few outdoor clocks now existing in a suburban area in the United States. With a history of its own, it is located in one of the most historical sections of the country. Across the street from the Churchill bank in which the clock rests is the Old St. John's Church where Patrick Henry made his famous speech, and a hundred yards down the street is the site of the Old Libby Prison, where Union soldiers were incarcerated during the Civil War.

YORKTOWN BENCH BUILT FOR PRECISION CRAFTSMEN

Designed for watchmakers, jewelers, engravers and precision workers is the Yorktown Bench, Model No. 100, manufactured by the Yorktown Manufacturing Company, Pilot Grove, Missouri.

The bench, which is sold through jobbers, is of all-wood construction with metal drawer runners where construction permits. Drawers are of tenon and groove construction, with 1/8 inch noise absorbing masonite bottoms and extra long sides which prevent accidental dropping of

SPEEDY DIAL REFINISHING
EFFICIENT • DEPENDABLE
FREE: Refinishing if you damage refinished dial. 1 year Guarantee on all dials.
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Send your order now for this fast selling 7J precision time piece especially priced for quick, steady turnover.

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drawers when extended.

It is constructed of solid woods and resin-bonded plywood, which, according to the firm, makes the bench impervious to any moisture, rust, oxidation, condensation and precipitation likely to cause tools to rust and oil to become sticky.

The Yorktown Manufacturing Company also produces unfinished benches, and future plans include a complete bench line, watch repair racks, and jewelers' wrapping counter.

For further information write the firm direct.

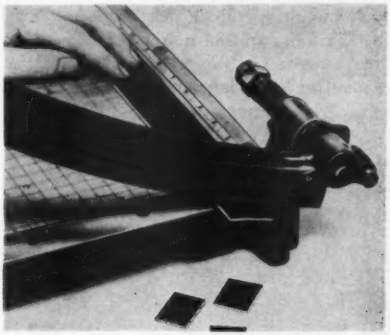
GRAVOFLEX PLASTIC IS NEW PRODUCT OF HERMES CORP.

Of interest to the retail jeweler is a new development in the plastics field which has just been announced by Hermes Plastics, Inc., a subsidiary of New Hermes Engraving Machine Corp.

From the material, which is a flexible laminating plastic called Gravoflex, jewelers may now make their own price tags, window signs and other attractive name plates right in their own stores.

Gravoflex, according to the firm, can be engraved with the help of any New Hermes engraving machine, and lettering can be cut through the top layer of the "sandwich" and will stand out permanently on a contrasting background. No paint is used. The material is tough, but not brittle, and its flexibility allows anyone to form it or bend it by hand to any shape.

Gravoflex is suggested by the company as the ideal engraving material to be fastened to round trophy bases. The engraving is done first on the flat plate, and is then bent and attached to the base. The making will not be distorted after bending or forming.



This plastic material can be cut with any ordinary paper cutter or shear, and can be nailed on curved or uneven surfaces without pre-drilling. It is absolutely scratch-proof, weather-proof, stain-proof and non-breakable, the firm adds. It is available in cut plates, sheets, or strips.

Further information about Gravoflex can be obtained by writing to Hermes Plastics, Inc., 13-19 University Place, New York 3, N. Y.

* * *

Beginning with this issue, The American Horologist & Jeweler is reprinting the publication "Technical Horology," by T. D. Wright.

Although "Technical Horology" is not a modern book in the strictest sense, it deals with a never-aging subject. W. H. Samelius calls it one of the best books in technical history ever written, and a real education to the reader.

The 114 pages of "Technical Horology" will be presented monthly by A. H. & J. in 16-page inserts, numbered as the original book pages are numbered.

TECHNICAL HOROLOGY.

T. D. WRIGHT.

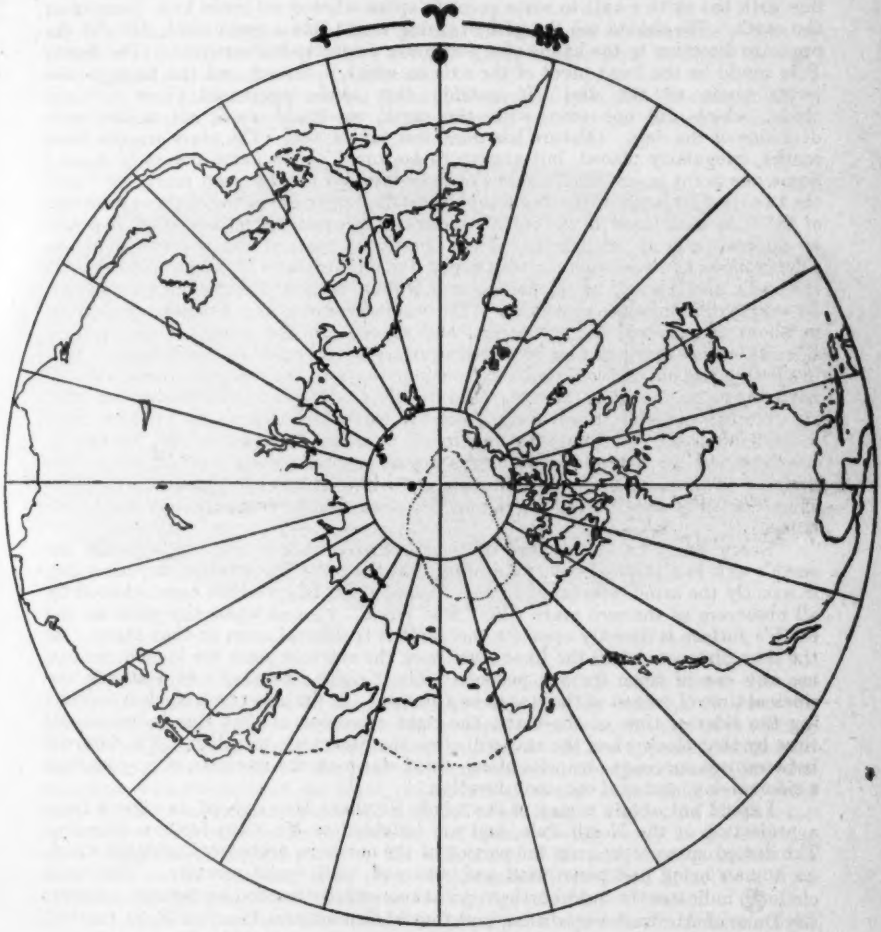


FIG. 1.

In the measurement of time, our first necessity is a constant standard, some interval of uniform duration which we can frequently and carefully measure. Nature has supplied us with such a standard. The earth itself is an accurate timepiece, turning on its axis with such uniform speed that no one has been able to detect the least variation in the time of any two consecutive rotations.

Scientists tell us that a time will come when it will slow down ; that, like a great top which has been spinning a long time, it has already commenced to wobble. We need not seriously trouble ourselves on that score, the changes during a human life time are so small that the time of one turn of the earth in the youth of our grandparents was, so far as we can measure, precisely the same as it will be in the old age of our grandchildren. No timepiece made by man has ever, or will ever, for any long interval, mark time so accurately as our earth does in its daily rotation.

Suppose we could go to the North Pole and be marconigrammed in a direct line with the earth's axis to some point in space whence we could look directly at the earth. We should see the globe turning round like a great clock dial, in the opposite direction to the hands of a clock, at a perfectly uniform rate. The North Pole would be the front pivot of the axis on which it turned, and the Equator the outer circle of the dial. If outside this circle we could place a fixed circle, which did not turn with the earth, we could mark on it the sub-divisions of the day. (Nature has done this for us, too. The stars are the fixed marks, irregularly placed, but always to be found at the same points in space.) Some one point in the fixed circle would be selected for the noon mark " ♈ " and the twenty-four hours of the day would be marked right round the circle at intervals of 15°. As each place on the earth's surface came opposite the zero mark it would be sidereal noon at that place. When Greenwich reached this point it would be sidereal noon at Greenwich ; some twenty-five minutes later Dublin would arrive at the mark, and it would be sidereal noon at Dublin, while at Greenwich it would now be twenty-five minutes past noon. The wide expanse of the Atlantic would pass in about four hours, then America, and so on. In the course of twenty-four sidereal hours every point on the earth's surface would reach the noon mark. This has been going on, and will probably continue to go on, for many centuries without any perceptible change in the rate, thus furnishing us with a reliable measure of time.

We are not able to get away from the earth and observe its rotation from some fixed point. We have to remain at, or near, its surface ; but we can do nearly as well by fitting up an observatory at any convenient spot on the earth's surface. This may be a scientific institution like Greenwich Observatory, " The Time Centre of the World," or it may be some simple installation in one's own home.

Every point on the surface of the earth describes a true circle round the earth's axis in a sidereal day. Knowing that the earth turns round day after day in exactly the same interval of time, a distant point in space has been selected by all observers as the zero mark (the " first point " ♈), and when any place on the earth's surface is directly opposite the point it is sidereal noon at that place. As the time distances of all the fixed stars from the starting place are known, we can use any one of them for our purpose. The " right ascension " of a star is the sidereal time of transit of the star at any station. If the observer's clock is indicating the sidereal time of the place, the right ascension of that star indicates the time by that clock when the star will cross the observer's meridian. The interval between two successive transits of any fixed star over the meridian of any place is a sidereal day, and is of constant duration.

I could not obtain a map of the whole Northern Hemisphere, as viewed from a projection of the North Pole, and am indebted to Mr. Otto for this drawing. The dotted space represents the portion of the northern Arctic region within which no human being had penetrated and returned, until quite recently. The small circle ⓝ indicates the most northern point successfully reached by Nansen. Later, the Duke of Abruzzi's expedition, and that of Commander Peary, U.S.A., reached further north.

In Fig. 1 the whole Northern Hemisphere is shown divided into twenty-four equal parts by meridian lines 15° apart. A round dot indicates the Greenwich meridian. The fixed point ♈, outside the earth, represents the " first point " from which the right ascension of every celestial body is reckoned.

Although the earth is so immaculately regular in its time of rotation, it has, like most of its inhabitants, certain little irregularities. To closely intimate observers these eccentricities may be of great importance, but if viewed from a sufficiently distant point, the inaccuracies become so insignificant as to be unnoticeable.

The apparent motions of the sun and of the stars are mainly due to the motion of the earth. The earth rotates on its axis in a direction opposite to that of the hands of a watch at a perfectly uniform rate once a day ; it revolves round the sun, also in a direction against the hands of a watch, at an irregular rate once a year. If its only motion were the one of uniform rotation we could select any fixed object away from the earth as a mark, and by noting the successive reappearances of that object, measure equal intervals of time. In consequence of the change of place of the earth in its orbit from day to day, we find that the interval between the re-appearances of a comparatively near object and that of a very distant one, is not the same.

The sun is comparatively near to us, the stars are at immensely greater distances, the nearest being nearly 200,000 times farther from us than the sun while others are very much more distant.

In a year the earth goes round the sun, it does not go round the stars at all, it merely describes a comparatively small elliptical path at an enormous distance from them.

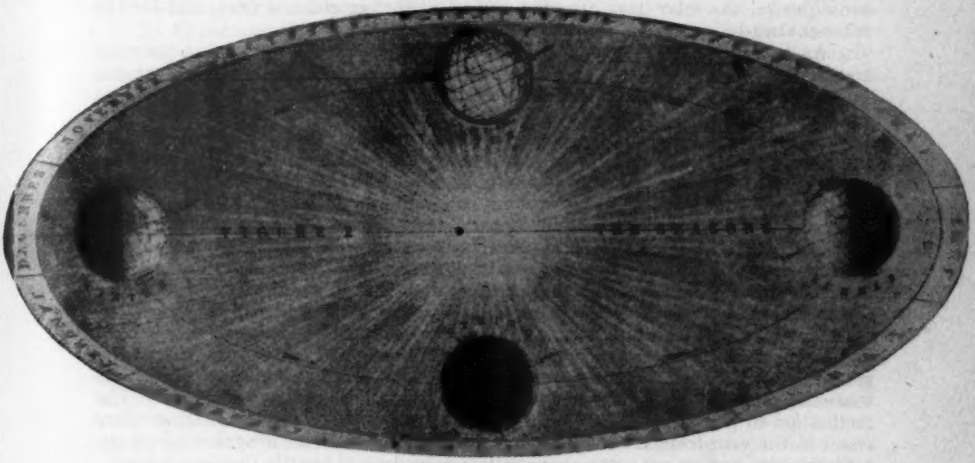


FIG. 2.

Fig. 2 is intended to represent the annual journey of the earth round the sun. In the illustration the sun is, say, where the black spot is, while all the stars are immensely distant outside the oval. As the earth turns round it also travels along the orbital path in the same direction as it rotates, *i.e.*, in the opposite direction to the hands of the watch. If the path were a true circle, the speed along that path constant, with the axis of the earth perpendicular to the plane of its orbit, solar days would be as regular as sidereal ones, although longer, and would become the natural and convenient scientific standard of time. Owing partly to the irregular speed along the orbit, and partly to the inclination of the axis, no two consecutive solar days are of equal duration. Our civil standard, the Mean Solar Day, is an artificial standard, equal in duration to the average solar day.

Let this oval represent, to *scale*, the annual path of the earth, and let a light high above the Eiffel Tower in Paris represent, *to the same scale*, one of the fixed stars, one can realise to some extent the immense difference between the distance of the sun from the earth and that of the stars. A ray of light takes eight or nine minutes to reach us from the sun. It takes a hundred years to reach us from some of the stars. The consequence is that, although the movement of the earth in its orbit causes a noticeable change in the relative positions of the earth and the sun, it has no sensible effect on the relative positions of the earth and the stars. Look at the earth on the right of the picture. A ray of light from the sun is falling on an observer ; a similar ray of light, from a star above or below the sun, is falling on the same point. Although the earth takes three months to move from the position on

the right of the picture to that at the top, we may imagine what would happen if it moved to that point while it made one turn. The man with the light on the Eiffel Tower could not tell that an object in this room had moved.

The two parallel rays would appear as one. Look at a long stretch of straight railway line, and notice how quickly the lines appear to converge. The few inches here would be unnoticeable. When the turn was complete, the light on the tower would be opposite the observer again, but the ray from the sun would be far away—a quarter of a turn away. The sun would appear to have moved backward from its place among the stars.

Or, suppose that while the earth made one turn it moved from the right of the picture to the position on the left. When the turn was complete, the star would be exactly opposite the observer again. Sidereal noon would have come once more, and the sidereal day would be complete, but only half a solar day would have elapsed, as it would be midnight with that observer, so far as solar time was concerned. It takes six months really to lose that half a solar day, and in the complete year there are less solar days than sidereal ones—one less exactly. In consequence, the solar days are all a little longer than sidereal ones, and for the reasons already mentioned are of irregular length.

As, however, the amount of irregularity is accurately known, we can use solar transits as a means of checking the rate of a clock just as well as sidereal transits. In several ways solar observations are better for watchmakers; the calculations are easier, and the observations more conveniently made.

The interval between the successive transits of any fixed star is always the same, because, (1) the earth rotates at a perfectly uniform rate, (2) the stars are "fixed," (3) they are at such an immense distance from the earth that the motion of the earth in its orbit during one day produces no measurable change in the apparent position of the star. The earth does not move along its orbit with uniform velocity, it goes faster, therefore farther, on some days than others, going fastest when nearest the sun; remembering that it *always rotates on its own axis at a perfectly uniform rate* we see that on those days that it has moved over a greater distance it will have to describe a larger angle to bring the sun again on the meridian—the interval will be longer. If it did move over equal distances in equal times and the orbit remained an ellipse, the intervals would still be irregular, because a given distance along the flatted curve of an ellipse would embrace a larger angle than the same distance along the quicker curves at the ends of the oval. The inclination of the earth's axis—sometimes inclined towards the sun, and at other times in the year from it—is by far the greatest cause of the irregularities of the solar transits, and we get no two consecutive solar days of exactly the same length.

Draw a horizontal line representing the equator. The sun is on the equator in March and September. Map out the altitudes above and below the equator throughout the year. It will be easily seen that in midsummer and midwinter, when the ecliptic is sensibly parallel with the equator, the change of altitude from day to day is small and almost all the apparent displacement of the sun will be an angular displacement; whereas in Spring and Autumn, where the ecliptic is much inclined to the equator, a good deal of the displacement will be used up in change of altitude and the angular displacement along the equator will be less.

As it would be neither convenient nor possible to construct machines that would precisely follow the irregularities of the solar transits, an artificial day is selected equal in length to the average duration of the interval between two transits of the sun.

Sidereal Time is time by the stars, the standard being the *Sidereal Day*—the interval between two successive transits of any one of the fixed stars, or the time taken by the earth to make one exact turn on its own axis. The duration of this interval is constant.

The Greenwich sidereal clock indicates the sidereal time at Greenwich, and is reckoned from noon (0 hours, 0 minutes, 0 seconds) onwards round the twenty-four hours. On, or about, March 22nd, the sidereal clock and the mean solar clock agree, but not at any other time in the year, as the sidereal one gains on the other one about 3 mins., 56 secs. every day. At this time of the vernal equinox, when the two clocks agree, there will be one occasion when two transits of the first point take place on the same solar day (reckoning the solar day from mean noon to mean noon), the first shortly after mean noon and the second shortly before the next mean noon.

Solar Time is time by the sun, the time indicated by a good sun-dial. *Solar Day* is the interval between two successive transits of the sun; the duration of this interval is irregular.

Mean Time or *Clock Time* is time as determined by the transits of an imaginary sun crossing the meridian at regular intervals. *Mean Solar Day* is an interval equal in duration to the average length of all the unequal solar days in the year, and is of course of uniform duration.

Sidereal time is the time used for most astronomical purposes, and for observatory work.

Mean time is the standard used for civil purposes in everyday life. The mean day is about 3 min. 56 sec. longer than the sidereal day.

Equation of time is the difference between mean time and apparent solar time, showing how long before or after clock-noon the sun will be on the meridian. On four days in the year—April 15th, June 14th, August 31st, and December 24th—the sun and the clock agree; at all other times in the year the sun is on the meridian before or after the clock-noon by an amount given in the almanack for every day in the year, under the heading of "Equation of time."

At Christmas time the solar days are about half-a-minute longer than the clock days, so a week after Christmas it will not be noon by the sun until nearly 4 mins. after 12 o'clock.

The equation for January 1st is 3 mins. 54 sec. sun after clock, that means—the sun will be on the Greenwich meridian on January 1st at 3 min. 54 sec. after twelve. The equation therefore always gives us the accumulated daily differences that have accrued since last the sun and clock agreed. From Christmas the solar days grow shorter but continue longer than the clock days until about February 10th, by which time the equation has grown to sun after clock 14 min. 30 sec. The solar day, which at this time is equal in length to the clock day, continues to grow shorter, decreasing the equation day by day until about the middle of April, when the sun and clock agree; still continuing to grow shorter until the middle of May, by which time the sun is on the meridian nearly four minutes before twelve. Then they begin to lengthen again a few seconds a day, getting longer and longer each day, and in June the sun and clock agree again; still they go on lengthening until the end of July, when the sun is after clock more than six minutes; again they decrease in length, and by the end of August clock and sun agree; still continuing to get shorter until the beginning of November, by which time the sun is before clock more than sixteen minutes, the solar days, which are now growing longer, again continue to increase in length, so that sun and clock agree again at Christmas.

The rate at which the equation alters depends upon the part of its orbit that the earth is in. When it reaches the same point in its orbit under like conditions the equation will be the same. The equation is not the same from year to year—that is, it will not be the same to-day as it was on the same date last year, because the year does not consist of an exact number of days. It takes the earth nearly $365\frac{1}{4}$ days to complete its annual journey. By calling 365 days a year we find the earth is a quarter of a day's journey behind, and the equation to-day will be something between what it was on the same date last year, and what it was on the day before that. In four years the earth would be nearly a day's journey behind, the equation would differ by one day's amount, so every four years (leap year) we add one more day to the year, to allow the earth to reach the same point in its orbit, and at intervals of four years the equation almost agrees. It does not quite agree, because the year is not quite $365\frac{1}{4}$ days, and in allowing an extra day every four years we allow a little too much; this is corrected at pre-appointed times—about once in a century—by missing leap year. Leap year was missed in 1900.

The *Terrestrial Meridian* of any place is an imaginary circle drawn over the surface of the earth directly from pole to pole, and passing through the place itself. The *plane of the meridian* is the plane in which that circle lies. The *Celestial Meridian* is the imaginary circle traced in the heavens by the extension of the plane of the terrestrial meridian.

The *Celestial Poles* are the vanishing points of the projection into space of the poles of the earth. The *celestial equator* or *equinoctial* is a circle of the heavens marked out by the indefinite extension of the plane of the earth's equator. The angular distance of a place on the earth's surface north or south of the terrestrial equator is called its *latitude*. The position of a place on the earth, east or west,

may be reckoned from any selected starting point, the meridian of the selected place being called the *prime meridian*. The meridian of the Greenwich Observatory is our prime meridian, and is the meridian from which nearly all the modern official clock times of the world are calculated. The angular distance between the prime meridian and the meridian of any place, east or west, of it, is called the *longitude* of that place. As the earth is round, places east and west of one another cannot have any fixed celestial body on their separate meridians at the same instant, but in the course of 24 hours that body will be on the meridian of every place on the earth in consequence of the earth's diurnal rotation. The equator of the earth and all the circles parallel to it (called parallels of latitude) are supposed to be divided, like all circles, into 360 equal parts called degrees, the degrees are divided into 60 equal parts called minutes, and these again divided into 60 equal parts called seconds. *Longitude* is measured in these divisions, reckoning east and west from Greenwich up to 180°, where the east and west reckonings meet. As 1° is the 360th of the circle, one degree will be passed over in the 360th of a day, or four minutes of time, so that a place 1° west of Greenwich would not have the sun on its meridian until 4 minutes after the sun had crossed the Greenwich meridian.

Local time is the time of a place as calculated from its own meridian; it is before or after Greenwich time as the place is east or west of Greenwich, and varies directly as the longitude of the place, in the proportion of 4 minutes of time to each degree of longitude.

Ex.: The longitude of Dublin is 6° 20′ 15″ W. What is its local time?

6°	20′	15″
		4
25	21	0

Ans. 25 min. 21 sec. *after* Greenwich.

The local time of Paris is 9 min. 21 sec. before Greenwich. What is its longitude?

4)	9 min.	21 sec.	
Ans.	2°	20′	15″ E. of Greenwich.

Standard Time is the local mean time of some selected place, used as the clock time for the surrounding district, or for the whole country when that is not of great extent. The local time of Greenwich is the standard for Great Britain. It is called noon all over Great Britain at the instant the mean sun is on the meridian of the Greenwich Observatory. "Greenwich time," "Clock time," "Railway time," and "Standard time," are synonymous terms in this country. The local mean time of the Dublin Observatory is the standard for Ireland. In America it is necessary to have several standards, differing from each other by one hour exactly, and from Greenwich by 4, 5, 6, 7, and 8 hours respectively. Nearly all civilised countries adopt standards based on the Greenwich meridian. The minutes and seconds hands of all clocks and watches in these countries agree. The hours only differ. Mid-Europe Time now adopted in Germany, etc., is exactly one hour fast of Greenwich.

As the interval between the transits of any one star at two different places is always exactly proportional to the difference in their longitude, a comparison between the times of the respective transits affords a ready measure of longitude. Before the introduction of the telegraph it was possible in conveying a chronometer from one place to another distant one that the rate might be disturbed and so cause slight inaccuracies. Now it is possible to compare the times of the clocks of two distant observatories with great exactness by telegraph, and by carefully observing the time occupied between the transits of the same object at the two different stations to absolutely measure the difference in longitude. At sea longitude may be determined by the aid of the sextant and the chronometer. By the sextant the mariner can determine the instant when the sun is on the local meridian. If the rate of the chronometer is reliable he knows the Greenwich time at the moment of the passage of the sun, and after correcting for equation has only to convert the time of his transit, before or after Greenwich noon, into degrees of longitude to determine his position east or west.

Declination = distance in degrees, along any meridian, north and south of the "equinoctial," or "celestial equator." The celestial equator is obtained by projecting the earth's equator into space, the altitude at which it crosses an observer's meridian will therefore depend upon his latitude. At the North Pole the celestial

equator would bound his horizon, he would see all objects having a north declination, but none having a south declination. On the equator of the earth, the celestial equator would cross the observer's meridian directly overhead at an altitude of 90°, and at all other latitudes the central point of the arch formed by the equator above the observer's horizon, *i.e.*, the point where it crosses his meridian, will be at an altitude above his horizon equal to his distance from the pole. 90°—latitude = co-latitude = polar distance = altitude of equator at the point where it crosses observer's meridian. Once this has been determined for any given place it never alters. For example, the latitude of some point in London is 51° 30′ N. Then the altitude of the equator at that point = 90°—51° 30′ = 38° 30′.

The altitude at which any celestial body will cross the meridian, of that point = 38° 30′ *plus* the *N.* declination of the body, or 38° 30′ *minus* the *S.* declination of the body.

Ex. :—On May 31st the sun's declination was 21° 52′ N. At this point in London, having a latitude 51° 30′ N., the sun will cross the observer's meridian at an altitude of 38° 30′, + 21° 52′ = 60° 22′. The transit instrument must be elevated to an angle of 60° 22′ for the sun to cross the middle of the field. In the middle of January, Sirius, the " dog-star " had a declination 16° 30′ S., then its altitude above the London horizon at time of meridian passage would be 38° 30′—16° 30′ = 22°.

Right Ascension of any celestial body is the angle, measured, not in degrees, but in sidereal time, eastwards from a circle perpendicular to the celestial equator, and cutting it at a point where it is intercepted by the ecliptic. This point is spoken of as the vernal equinox, or the " first point " (♈). When ♈ is on an observer's meridian it will be local sidereal noon at that place, and if his sidereal clock is set to his local sidereal time the right ascension of a star will be the time by that clock when the star will transit his meridian. The clock has a twenty-four hour dial, the R.A. is reckoned from 0 to 24 hours, and all stars above the horizon will cross his meridian in the complete sidereal day, at the times given as their respective Right Ascensions.

When it is desired to check the rate of a Mean Time Clock by sidereal observations several calculations are necessary. The known polar distance of the place ± the given declination gives the altitude to which the transit instrument must be elevated for the star to enter the field of the telescope. The R.A. gives the time angle of the star from ♈. The " sidereal time at mean noon " (call this S.T.) tells us how much of this angle has passed the meridian when it is mean noon by the clock. (The Nautical Almanac furnishes the " Sidereal time at Mean Noon at Green wich " for every day in the year, as well as all the other necessary data.)

Therefore, R.A.—S.T. = the interval, in sidereal time, after mean noon, when the star will be on the meridian. Suppose R.A. = 12 hours, S.T. at Greenwich = 4 hours, then the time of transit will be 8 sidereal hours after mean noon, and if the place is 3° W., the transit will occur 8 hours 12 mins. (sidereal) after noon. G.M.T. When the S.T. is greater than R.A., add 24 hours to the latter before subtracting. Suppose the R.A. = 7 hours, and S.T. = 23 hours, then 7 + 24 = 31, 31—23 = 8 hours after noon. S.T. = 23 hours shows that ♈ will again be on the meridian 1 hour after noon, and as the star will be 7 hours later, the interval will be 8 hours.

Having determined this interval and made correction for longitude you must convert the sidereal time into its equivalent value in Mean Solar time to determine the time the Greenwich mean clock should be indicating when the star transits the given meridian.

The Nautical Almanac furnishes tables of equivalent values. If you have not the tables by you remember that one sidereal hour = 59 min. 50·17 secs. of mean solar time, a difference of 9·83 seconds. Subtract from the sidereal interval 9·83 sec *per hour* to obtain Mean Solar Time.

Time is primarily determined by astronomy, whole days being measured by astronomical observations. The sub-divisions of the day are usually measured by machines. The earliest method of measuring time would probably be the observation of Sunrise and Sunset. In equatorial countries these phenomena would occur at fairly regular intervals, the sun rising and setting about 6 o'clock all the year round. But in high or low latitudes it would have soon been observed that the intervals varied at different times of the year. Then would naturally follow the observation of shadows of fixed objects cast by the sun, and it would be observed that the shortest shadow was always cast at mid-day when the sun appeared at its

greatest altitude. It would also be noticed that the interval from noon to noon appeared to be fairly constant in any latitude, thus becoming a more universal measure of the day than the intervals between sunrise or sunset.

Later on a rough sub-division of the hours of daylight would be made by noting where the shadows of some fixed natural object were successively cast, such observations leading eventually to the invention of the sun-dial.

The sun-dial can only be used when the sun shines ; it indicates from noon to noon the apparent solar day, which is an interval of irregular duration, and at other hours of the day it is subject to variations due to refraction, the effects of which are greater as the sun is nearer the horizon. Refraction is the bending of a ray of light caused by the ray passing into a medium of different density. A ray of light from the sun is bent when it enters the atmosphere surrounding the earth, so that the shadow of the style is not cast in its right place, the bending of the ray is greater as the ray is more inclined to the surface of the medium that it enters, so the effects of refraction are greatest in the early morning or late evening ; the bending is also greater when the density of the medium is greater, consequently as the density of the atmosphere varies the refraction varies, and its effect is not constant for any one place nor any one time in the day. When the ray is perpendicular to the surface there is no refraction, its effect therefore at or about noon may be neglected, because refraction at noon, will only alter the *length* of the shadow, not its position ; and as the variations in the length of the solar day from noon to noon are accurately known, the sun-dial is a good meridian instrument. Having observed the instant when noon is indicated by the dial, we must add or subtract the " equation of time " for the day of observation to obtain mean noon.

The sun-dial to show correct solar time throughout the day must have the gnomon or style so fixed that its edge, casting the shadow, must be parallel to the axis of the earth. A dial made for the latitude of London would not be correct for that of Egypt. At the equator the gnomon would be horizontal, at the poles it would have to be vertical, and at every other part of the earth's surface it must be so fixed that the angle it makes with the horizontal is equal to the latitude of the place. The dial itself may be horizontal, vertical, or at any required inclination.

A meridian dial is a sun-dial intended for use at noon only, the style may be vertical ; it is not necessary that it should be inclined for latitude. As it is easily made and fixed, and very useful, every watchmaker who does not possess a transit instrument should make one.

Although a sun-dial may have faults, it is, if properly fixed, always absolutely correct at the instant of apparent solar noon. Correct, that is, so far as apparent solar time is concerned. This differs from mean time by an amount given for each day in the year in astronomical almanacks, under the heading of " Equation of time "—the amount to be added to, or subtracted from, the observed apparent time to obtain average or mean time. Thus, if the equation of time for to-day is given as " sun after clock 14 min. 11 sec.," I know that, if my watch is indicating the mean time of the place, the sun will transit the place, and the sun-dial will indicate noon when the watch is 14 min. 11 sec. past twelve o'clock. If the watch is set to Greenwich time, and the place is not on the Greenwich meridian, corrections must be made for difference of longitude.

This illustration (Fig. 3) represents a meridian dial, as suggested in one of the editions of the late Lord Grimthorpe's work on " Clocks and Watches." A metal plate is fixed vertically on a horizontal slab of slate, a long narrow vertical slit in the metal plate reaches from the slab up to a small round hole, so that when the sun shines on the plate, casting its shadow on the slab, a line of light is seen in the centre of the shadow, and if the dial were boxed in, except just in front of the slit, and on the northern side whence one reads it, the definition would be improved. If the longitude of the place, the equation for the day, and the exact Greenwich time are known, the meridian line, where the line of light will fall at the instant of noon, may be traced on the slate slab. It may, however, be accurately traced, without knowing anything of these details, by the method of equal altitudes. The sun traces an arch in the heavens, reaching the highest point at noon, when it casts the shortest shadow of any object. At equal intervals, before and after noon, it will be at equal altitudes, and will cast shadows of equal length.

From the foot of the slit we draw a series of arcs of circles, and mark the points where the top of the line of light—easily identified by the little round hole—just

reaches the same circle before and after noon. Bisect these points, and you have the true meridian line—once right, always right. The fixing is best done at the time of the summer or winter solstice, as at other times in the year there is a small change in the declination of the sun between the two observations ; but this can be estimated, and allowed for and checked by subsequent observations, before finally fixing.

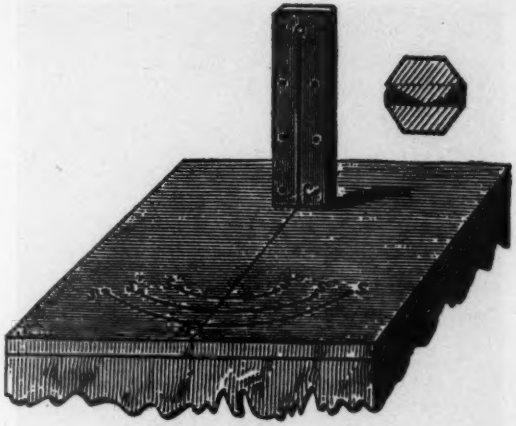


FIG. 3.

Another useful meridian instrument is the Dipleidoscope, consisting of a hollow triangular glass prism having one of its sides transparent, and the other two blackened to act as reflectors. (See Beckett, page 14.)

The instrument must be so fixed that the axis of the prism is parallel to the axis of the earth, the inclination, therefore, of the prism to the horizontal equals the latitude of the place where it is to be used. The prism need not be an equilateral one, but it is probably the most convenient form for description and construction. In every position but one, two images of the sun are seen, one by reflection from the front transparent glass, the other by reflection from the blackened glasses. The instrument must be so adjusted that the two images coincide at the instant of local solar noon.

The most perfect instrument for measuring sidereal or solar time is the Transit Instrument. Fig. 4.

This is a telescope, mounted so that it can only move in the plane of the meridian of the place where it is fixed ; that is to say, it can describe a half-circle, pointing from the south point of our horizon to the north point of the horizon. Mostly we only use it, for time purposes, from a point a little above the south horizon to some point short of the zenith. If properly fixed, the plane of the circle described at any inclination would divide the telescope into two equal portions, and would pass through the axis of the earth, dividing the earth itself into two equal portions. Unless it is so fixed, the observations at different inclinations will not be equally correct. At the point where the focus of the object-glass meets the focus of the eye-piece, an adjustable frame is fixed, carrying a thread from a spider's web stretched horizontally across the centre of the field ; and carrying an odd number of vertical spider threads similarly stretched on the frame ; the central vertical thread being adjusted in the optical axis of the telescope. If we are to take the transit of a star, the interior of the telescope must be illuminated so that we may see the spider lines. One of the pivots on which the instrument turns is hollow, and a lantern, placed at the side, lights up the inside of the tube. If the instrument is correctly set, the image of the star enters the field at the right-hand side on the horizontal line and passes along that line ; when it is on the central vertical line we note the time, as that is the instant of transit. The additional vertical lines aid us

in checking the central observation, and when we have determined the time intervals between the vertical lines, we may use the side lines at times when the central line is obscured by clouds. As the exact positions of all the fixed stars are accurately known, we can, in the course of one clear night, obtain transits of quite a large number of them ; and every one of them will help us in checking our clock, because we know the exact time at which each individual transit will occur.

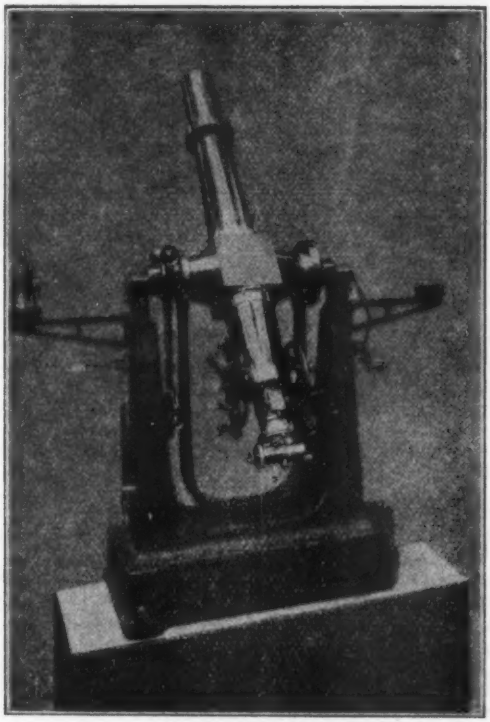


FIG. 4.

In observing the sun, no artificial illumination s necessary, and we must cover the eye-piece with dark glasses, varying according to the brilliance of the light. We see the sun entering on the right, as in the illustration (Fig 5.) When the centre of the sun is on the middle line, it is the instant of transit ; but the image is too large for us to tell where the exact centre is, so we note the time of contact of the " first limb " (the advancing edge) of the sun's image with the central line, and the time of departure of the " second limb " with the same line ; the mean of the two observations gives us the time of passage of the centre of the sun.

The additional vertical lines may be used in cloudy weather, or for checking the central observation.

Longitude may also be determined on moonlight nights by the sextant by the " Lunar Method." For a proper description of this method see " Herschel's Outlines of Astronomy." The visible surface of the starry heavens may be regarded as the dial of a clock, the stars are the figures, irregularly placed, but always in the same relative positions. The moon is the movable hand which goes round in a month, its apparent angular distance from all the principal stars for every three hours and every day is given in Greenwich time, as it would appear from the *centre of the earth.* At one of the given times the apparent angle between the moon and the star is measured with the sextant by the observer on the earth's surface. The

observed angle will differ according to the place where the observation is made, the difference being due to parallax. *Parallax* is an apparent change in the position of an object due to a change in the position of the observer. The moon is very near to us, the stars are very distant, and the effect is such as would be produced if we tried to read the time by a clock, the hand of which was a long way from the dial nearer

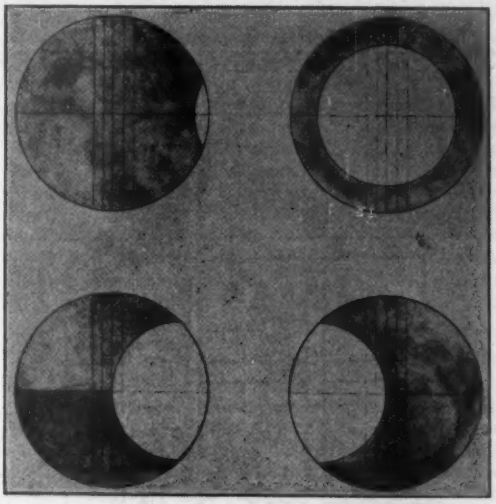


FIG. 5.

to us. The time would not appear to be the same to two people standing in different spots. The actual positions of the moon and stars are known, the difference between the apparent angle as seen by the observer and that as it would appear at the centre of the earth gives the observer a reliable means of determining his position on the earth's surface. The observation is easy, the necessary calculations are not.

The *Rational Horizon* of a person on the earth's surface is a horizontal plane passing through the centre of the earth beneath him, and continued indefinitely into space. All tabulated altitudes are calculated from the rational horizon.

The *Sensible Horizon* is a plane parallel to the rational and tangent to the earth's surface. The two horizons therefore are separate by a distance equal to a semi-diameter of the earth. The difference between the altitudes of an object above the sensible and rational horizons, is called the *parallax in altitude*. The sun's parallax is about 9″ of arc, the moon's is much greater, and varies as it is nearer or farther from the earth. The stars are so distant that they have no parallax.

The *Visible Horizon* is the horizon as it appears to the observer. If he were floating in the sea with his eyes on the sea level, then his visible horizon would be his sensible horizon, but in ascending from the sea level his visible horizon would dip below the sensible, and the dip would increase the higher he ascended. In determining the true altitude of an object from an observation several corrections have to be made. From the observed altitude—

Subtract the error due to refraction: this will vary according to the pressure of the barometer and angular height of object, then—

Subtract the error due to dip of horizon, this will vary according to elevation of observer above sea level. When these two corrections (which are always subtractive and have to be made in observing all celestial bodies) have been made we have the height above sensible horizon. Then—

Add the correction for parallax and we have the true altitude above the rational horizon. The last correction is 0 for the fixed stars.

TIME-MEASURING MACHINES.

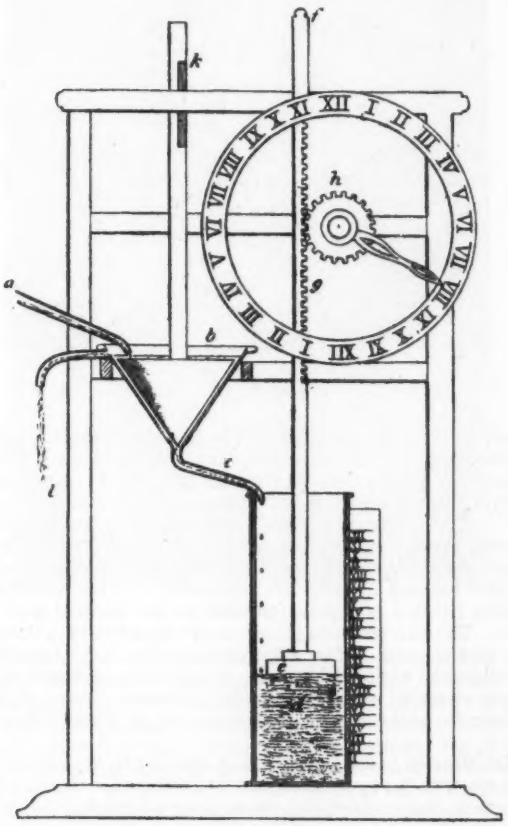


FIG. 6.

The earliest form of machine for measuring time was the clepsydra, or water-clock.

If a vessel of uniform section filled with water be allowed to empty itself through a hole in the bottom the velocity of the outflow will not be uniform; as the level of the surface sinks the velocity is less, and divisions marked on the vessel to denote equal intervals of time will have to be at unequal distances apart, being closer together as they get nearer to the bottom. If this result had not been foreseen it must have soon been detected, and some means adopted to obtain equal

measurements, either by irregular divisions on the scale or by causing the water to flow with uniform speed. When a vessel of water is kept *always full* the pressure at any outlet from it remains the same, and the water will flow through the opening with uniform velocity. The later forms of water-clocks have an overflow pipe to the cistern, which is filled from any convenient and ample source, *so that the water in the cistern is kept at one level ;* the pressure then remains constant, the flow from it uniform, and equal quantities of water represent equal intervals of time. The water is allowed to flow into a cylindrical jar, equal divisions on which, marked from the bottom upwards, represent equal intervals of time. In some a float, to which is fixed an upright rack, rests on the surface of the water in the receiving vessel. As the water rises the rack turns a pinion to which a hand is fixed in front of a circular dial. They are fairly accurate time measurers, and are used to the present day in modified forms for special purposes. Sometimes mercury is used instead of water, the intervals of time being determined by *weighing the mercury* that flows from the vessel ; they can thus be used for measuring very small fractions of time, as the motion is continuous, whereas a pendulum clock cannot divide the intervals *between* the beats of the pendulum. A clock with a seconds pendulum can only measure seconds, it cannot measure fractions of a second, because between the " escapes " the whole of the mechanism of the clock itself is absolutely at rest.

A clock is a machine for counting and automatically recording the vibrations of a pendulum. It has also at regular intervals to give impulse to the pendulum, so as to restore to it the energy that it loses in overcoming the various resistances that tend to bring it to rest.

A clock consists of—

(1) The *pendulum*, which is the time measurer (practically no clock is complete without a pendulum, or its substitute a balance and spring, or some other regulating arrangement, but in a certain sense we may consider them as two distinct things, the pendulum is an instrument measuring equal intervals of time, the clock is a machine that counts and records by appealing to our sense of sight, or of hearing, those equal measures of time).

(2) The *motive power*, which is usually derived from a raised weight or a coiled spring (sometimes other agents are used, such as electricity).

(3) The *train*, that series of wheels and pinions gearing together which conveys the energy stored up in the raised weight, or coiled spring, to the escapement. The train is also arranged to cause different arbors to rotate with different speeds so that we may place hands upon them to measure any convenient intervals of time, such as hours, minutes etc. It also enables us to transmit the energy in small quantities lasting over a long period of time.

(4) The *escapement*, that part of the mechanism which controls the expenditure of energy, permitting that energy to " escape " at intermittent intervals to the pendulum, and arresting the motion of the machine between the beats.

(5) The dial and hands and the bells to record the number of vibrations, and enable us to read or to hear the time.

Any body free to vibrate about an axis that *does not pass through its centre of gravity* is a pendulum. A clock pendulum generally consists of a long light rod suspended from one end, with a small heavy bob at the other end.

Galileo appears to have been the first to observe that the vibrations of a pendulum were isochronal. That is, he noticed while watching a swinging lamp in the Cathedral at Pisa, that whether it was describing a very large arc or a small one, the time occupied in making one swing appeared to be the same, and that the time only seemed to be different when the length of the pendulum was different.

To Huyghens is accredited the honour of first applying the pendulum to a clock. He also demonstrated that Galileo's observations were not strictly accurate, and that when a pendulum was describing very large circular arcs, it took slightly longer than when it was describing small ones. He proved that for the vibrations to be perfectly isochronal, the arc described must be a cycloid and not a circle. By

the invention of his " cycloidal cheeks " he caused pendulums to describe cycloidal paths, but he had to abandon them because the errors created by the varying friction of the cheeks were greater than those he endeavoured to remove.

If the motion of a pendulum could be maintained and its vibrations counted, without having to touch it, and if the surrounding influences never varied, its time of vibration would never change.

A freely-swinging pendulum set vibrating and left to itself would ultimately come to rest, because of (1) the resistance of the air in which it swings ; (2) the friction at the suspension. The pendulum of a clock meets also with a checking disturbance in the " interference " of the escapement.

The motion of a pendulum is primarily maintained by gravity. To set it vibrating it has first to be raised from its lowest position, it then falls by the action of gravity back to that lowest position with an increasing speed that is greatest at the instant of passing the lowest point. The energy stored up in the pendulum by the first lift becomes changed during the fall into motion, causing it to rise on the opposite side. If there were *no resisting influences* it would rise to exactly the same height, going gradually slower as it rose, coming for an instant to rest at the highest point, and returning in exactly the same manner as it started. Gravity would give to it during its fall just as much energy of motion as it takes away during the rise, and the pendulum would continue to vibrate for ever, always rising to the same height as it originally started from. Gravity, however, can give *no more* than it takes away, and as some of the energy is destroyed in overcoming the resistances referred to, we are obliged to supplement the action of gravity by giving an occasional impulse to the pendulum. A pendulum set freely swinging in a vacuum continues to vibrate for a much longer period than one swinging in the air, but even if the vacuum could be maintained perfect, it would eventually come to rest because there is no frictionless form of suspension.

With the old form of pivoted suspension there is considerable friction where the pivot rubs on its bearing. The knife edge suspension is vastly better, but still there is friction at the support. Suspension by a fine silk cord has proved exceedingly good for philosophical and laboratory experiments ; there is very little friction, but it is not often used in clockwork because it is delicate, and any accidental disturbance of the clock easily stops it. It is also subject to alterations of length when the humidity of the atmosphere varies.

The most popular and for ordinary clocks the best form is the spring suspension. The spring rubs against nothing, therefore there is no friction outside the spring, but still there is friction. When a spring is bent, the particles composing it are distorted and displaced about one another, setting up an internal rubbing productive of " molecular friction."

The thinner the spring is the less are the particles in it displaced about one another by a given amount of bending, and in no case should it be thick enough to act as a spring in the ordinary sense. It should be thin, short, and wide.

The mere fact that a pendulum has to overcome resistance during its motion does not necessarily produce irregularities in its time. If the resistances did not vary in intensity and if the force of the impulse communicated by the escapement remained constant, the time would not vary. The resistances do vary in effect.

When any of the causes tending to resist the motion of a pendulum vary in intensity, the rate of vibration is affected. The air in which a pendulum swings offers resistance. If the density of the air did not change, the resistance would be constant, and although the motion of the pendulum would be slower than when swinging in a vacuum, its rate would be equally steady. It is when the density of the atmosphere varies, as indicated by the barometer, that errors in the rate are produced by variation in the intensity of that resistance. It was found by experiment that a pendulum going to time under the ordinary pressure of the air gained 13 seconds a day in a vacuum, and as a space devoid of air cannot in any way be affected by barometric changes, clocks were made having the pendulum in an exhausted air-tight case. The error is too small to consider in the construction of an ordinary clock, the variation being only about one-third of a second per day for a change of one inch in the barometric reading ; but in astronomical regulators, and similar clocks of precision, the error can be detected.

Several methods have been successfully used for correcting the error.

The illustration represents the method designed by Mr. Ellis, and used to the present day in the sidereal regulator at the Greenwich Observatory. Two bar magnets, with opposite poles downwards, are fastened to the pendulum bob, one in front and one behind. A barometer tube is fitted in the clock case. An adjustable balanced lever carries at one end a float resting on the surface of the mercury in the

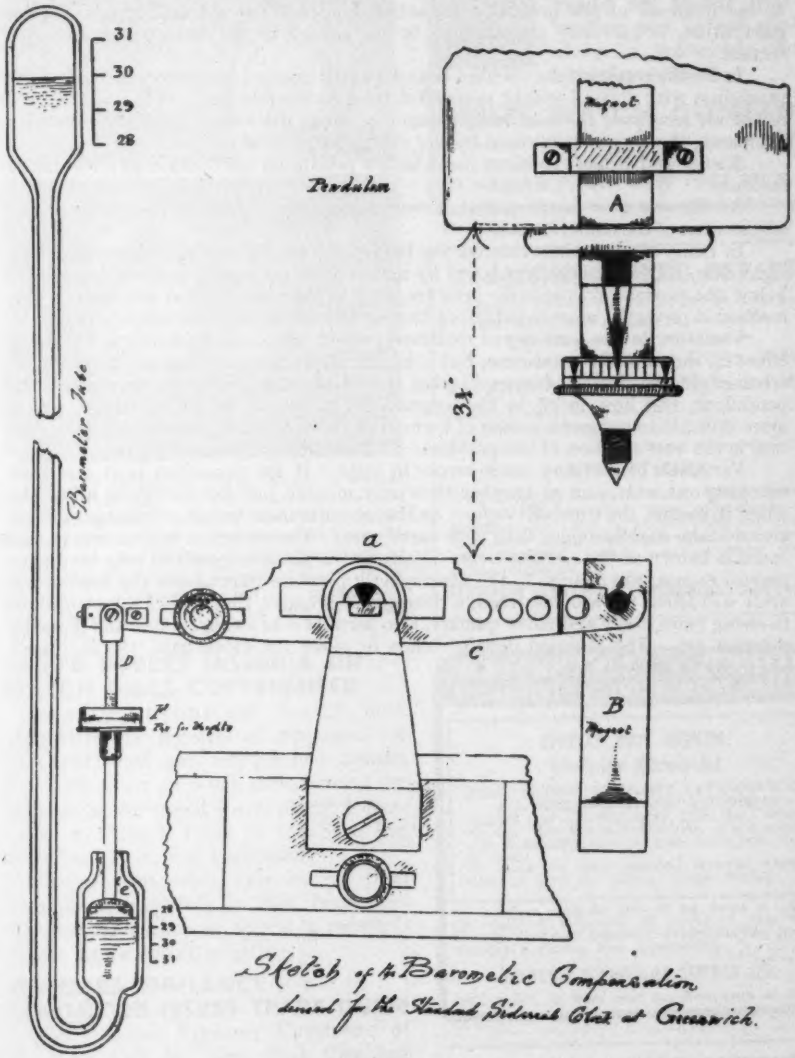


FIG. 7.

open end of the barometer tube; at the other end of the lever a horseshoe magnet is fixed with its north pole under the south pole of one of the magnets on the pendulum and its south pole under the north pole of the other pendulum magnet. The horseshoe is, therefore, always attracting the pendulum, its effect being greatest

when nearest to the pendulum. When the barometer rises under increased pressure, the mercury in the open end of the tube sinks, the float falls with it, the horseshoe approaches the pendulum, increasing its attractive effect; and when the barometer falls the float rises and the horseshoe recedes.

When the horseshoe is first placed under the pendulum magnets it will accelerate the vibrations. The magnetic attraction, acting in the same direction as the attraction of gravitation, reinforces the effect of gravity more or less, according to the nearness of the mutually attracting bodies. The attraction, like that of gravitation, is inversely proportional to the square of the distance between the bodies.

In Redier's system the vacuum box of a small aneroid barometer is fixed to the pendulum with a small weight suspended from its flexible end. When the density of the air increases, the box being pressed in, raises the weight: when the density decreases, the weight is lowered by the change of form of the box.

Riefler and Robert Gardner use a hollow pendulum rod containing a column of mercury.

As the error to be corrected is very small, great care is necessary in the adjustment of the contrivances.

In many modern observatories the barometric error is avoided by using an air-tight case. The pressure is reduced by means of an air pump, to some degree well below the normal atmospheric pressure, and is then maintained constant. This method is probably more satisfactory than a delicate mechanical arrangement.

Variation in the quantity of moisture present in the atmosphere has a sensible effect on the rate of a pendulum, but it is difficult to estimate how much of such an error might be directly due to varying humidity in opposing the passage of the pendulum, and how much to the hygroscopic nature of the oil employed. It is more difficult to suggest a means of correcting the error, and probably the air-tight case is the best solution of the problem. "Prevention is better than cure."

Variation of arc may cause errors in time. If the pendulum is at one time swinging out wide, and at another time only moving just far enough to allow the wheel to escape, the time will vary. As Huyghens demonstrated, very large circular arcs do take *slightly* longer than very small ones. The variation in time due to this cause is known as the *circular error*. Variation in the arc described may be due to several causes, the change in the atmospheric pressure that causes the barometric error will affect the arc described, a decrease of pressure that allows the pendulum to swing more freely and move quicker, also permits it to swing further and describe a larger arc. The lessened density tends to make the clock gain, the increased arc tends to make it lose.

CLOCK MANOR VISITORS

Mid-July visitors to Clock Manor in Denver included Ted Lang, architectural engineer and well known clock collector from Minneapolis, Minn., shown at left in top photo with Orville R. Hagans; and Harold Loevy, president of Zenith Manufacturing & Chemical Corp., N. Y. Mr. Loevy is shown in bottom photo with Mrs. Hagans, as guest at the Hagans' mountain home.

ARMED FORCES INSIGNIA ON WATCH DIALS COPYRIGHTED

Copyright registrations have been granted by the registrar of copyrights for both published and unpublished designs for work of art on watch dials bearing the insignia of the armed forces of the United States to Mary I. Nagy of 151 Savo Bay Road, San Francisco, California.

Plans for marketing have not yet been formulated, according to Mrs. Nagy, but the dials have a special appeal to members of the armed forces as gifts.

JEWELERS VIGILANCE COMMITTEE ISSUES TRADE GUIDE

The Jewelers Vigilance Committee of 45 West 45th St., New York City, last month released a booklet entitled "A Guide to Markings and Descriptions Used in the Jewelry Trade." A valuable contribution to the industry, the booklet explains the requirements of U. S. stamping

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A

Acon Watch Crown Co..... 74
American Horologist & Jeweler Book Department 16
American Time Products.... 80
Aristo Import Co., Inc..... 51

B

Bausch & Lomb Optical Co. 5
Bonded Messenger Service 74
Bowman Technical School.. 69
Bradley University 74
Burt, Edwin B..... 50

C

Clock Makers Guild of America 51
Coehler, Henry Co., Inc..... 51

E

Elgin National Watch Co... 25
Eterna Watch Co. of America 13

F

Fayma Dial Refinishing Co. 51, 74
Fleuron Watch Co..... 73

G

Geneva Dial Co..... 65
Glarden Importing Co..... 65

H

H.v.H. Tool & Instrument Co. 59
Hairspring Vibrating Co..... 33
Hamilton Watch Company 1
Hammel-Riglander & Co., Inc. 12
Herman Clock House, Ralph 49, 51
Hoover & Strong, Inc..... 49

I

International Dial Co..... 2

J

Jacoby-Bender, Inc. 15
Jadow, B., Inc.....14, 43
Joseph Brothers 65

K

Kaplan & Goldman..... 67

L

L & R Manufacturing Co... 23
Lampert, M. J. & Sons, Inc. 35, 61
Larsen Importing Co..... 59
Levin, Louis & Son, Inc..... 55
Lowe, B., Company.....73, 74

Mc

McCaw, William S. Co..... 74

M

Mark-Nelson Watch Co..... 74
Marshall, C. & E. Co....40, 41
Mereminsky, P. 27
Michigan Dial Refinishing Co. 49
Modern Technical Supply Co. 73

N

Naomi Quality Findings..... 9
Newall Manufacturing Co. 37, 47
New Hermes Engraving Machine Corp. 7
Nye, William F., Inc..... 56

P

Paulson, Henry & Co..... 71
Poltock, John A. & Co...61, 74

R

Reid, Burton M. Sons, Inc... 53
Ressel Watch Co..... 73
Rubin & Co..... 39

S

Schweingruber, Les Fils d'Emile 8
Seitz, Pierre 6
Silbert, M. J. & Co..... 29
Sobel, Henry & Co., Inc..... .....45, 63, 71
Standard Unbreakable Watch Crystals, Inc..... 79
Swigart, E. & J. Co..... 3
Swiss Federation of Watch Manufacturers 10, 11

T

Terwilliger, Charles 73

U

U. S. Watch Dial Co..... 71

Z

Zenith Manufacturing & Chemical Corp. 63

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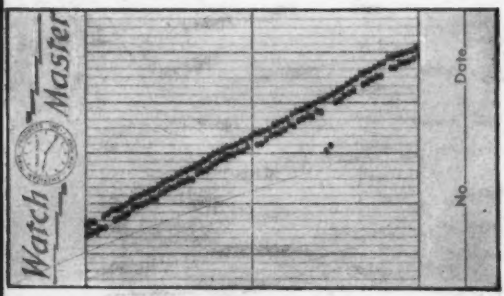

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